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THE ECONOMIC DISTURBANCES SINCE 1873.

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III.

[In the preceding article of this series (No. II) two propositions were submitted: *First*, that in the increased control during the last quarter of a century, which mankind has acquired over the forces of Nature, and the increased utilization of such control for the work of production and distribution, is to be found a cause amply sufficient to account for the almost universal and extraordinary economic disturbance which has prevailed since 1873, and bids fair in a greater or less degree to continue. *Second*, that all the other causes which have been popularly regarded as having directly occasioned or essentially contributed to the economic disturbance in question—with the exception of such as are in the nature of natural phenomena, as bad seasons and harvests, diseases of plants and animals, disappearance of fish and the like, and such as are due to excessive taxation, consequent on war expenditures, all of which are local, and the first temporary in character—naturally group themselves about the one great cause that has been suggested, as sequences or derivatives, and as secondary rather than primary in their influence. A summary of the evidence in support of the *first* proposition having been submitted, it is proposed in the following article to ask attention to the facts which seem to be confirmatory of the *second*.]

OVER-PRODUCTION.—Consider *first* the most popular alleged cause of recent economic disturbances, that to which the Royal Commission of Great Britain in its final report* (December, 1886), and

* "One of the commonest explanations of this depression or absence of profit is that known under the name of over-production; by which we understand the production of commodities, or even the existence of a capacity for production, at a time when the demand is not sufficiently brisk to maintain a remunerative price to the producer, and to afford him an adequate return on his capital. We think such an over-production has been one of the most prominent features of the course of trade during recent years; and that the depression under which we are now suffering may be partially explained by this fact."—*British Commission, majority report.*

"By over-production we understand the production of commodities (or existence of the agencies of production) in excess, not of the capacity of consumption if their distribution was gratuitous, but of the demand for export at remunerative prices, and of the

the United States Bureau of Labor* (1886) have assigned a prominent place; and which the "Trades-Union Congress of England has by resolution accepted as being, in the opinion of the workmen of England," the most prominent cause, namely, "*over-production.*" In a certain sense there can be no over-production of desirable products so long as human wants for such products remain unsatisfied. But it is in accordance with the most common of the world's experiences, that there is at times and places a production of most useful and desirable things in excess of any demand at remunerative prices to the producer. This happens, in some instances, through lack of progress or enterprise, and in others through what may be termed an excess of progress or enterprise. An example of the first is to be found in the circumstance that in the days of Turgot, the French Minister of Finance under Louis XVI, there were at times in certain departments of France such abundant harvests that wheat was almost unmarketable, while in other and not far-distant sections of the country there was such a lack of food that the inhabitants perished of hunger; and yet through the absence of facilities for transportation and communication of intelligence, the influence of bad laws, and the moral inertia of the people, there was no equalization of conditions.† An example of the second, intensified to a degree never before experienced, is to be found in the results of the improvements in production and distribution which have been made especially effective within the last quarter of a century. A given amount of labor, operating through machinery, produces or distributes at least a third more product on the average, in given time, than ever before. Note the natural tendency

amount of income or earnings available for their purchase in the home market. The depression under which we have so long been suffering is undoubtedly of this nature."—*British Commission, minority report.*

* "Machinery—and the word is used in its largest and most comprehensive sense—has been most potent in bringing the mechanically-producing nations of the world to their present industrial position, which position constitutes an epoch in their industrial development. The rapid development and adaptation of machinery in all the activities belonging to production and transportation have brought what is commonly called over-production; so that machinery and over-production are two causes so closely allied that it is difficult to discuss the one without taking the other into consideration. . . . The direct results, so far as the present period is concerned, of this wonderful and rapid extension of power-machinery are, for the countries involved, over-production, or, to be more correct, bad or injudicious production; that is, that condition of production of things the value of which depends upon immediate consumption, or consumption by that portion of the population of the world already requiring the goods produced."—*Report of the United States Commissioner of Labor, 1886, pp. 88, 89.*

† This experience of France in the last quarter of the eighteenth century is repeating itself at the present day in China. General Wilson, in his recent "Study of China" (1887), states that "over ten million people died from starvation about ten years ago in the provinces of Shansi and Shensi alone, while abundance and plenty were prevailing in other parts of the country. Every effort was made to send food into the stricken regions; but owing to the entire absence of river and canal navigation, as well as of railroads, but few of the suffering multitudes could be reached."

of human nature under the new conditions. The machinery which thus cheapens and increases product is, as a rule, most costly, and entails a like burden of interest, insurance, and care, whether it is at work or idle; and the possessor of it, recognizing this fact, naturally desires to convert outlay into income by utilizing it to the greatest extent possible. Again, a man who has learned by experience that he can dispose of a certain amount of product or service at a profit, naturally reasons that a larger amount will give him, if not a proportionally greater, at least a larger aggregate profit; and as the conditions determining demand are not only imperfectly known, but to a certain extent incapable of exact determination, he discards the idea of any risk, even if he for a moment entertains it, and pushes industrial effort to its maximum. And as this process is general, and, as a rule, involves a steady increase in the improved and constantly improving instrumentalities of production and distribution, the period at length arrives when the industrial and commercial world awakens to the fact that there is a product disproportionate to any current remunerative demand. In this way only is it possible to account for the circumstance that the supply of the great articles and instrumentalities of the world's use and commerce has increased, during the last ten or fifteen years, in a far greater ratio than the contemporaneous increase in the world's population, or of its immediate consuming capacity. But although such is substantially a correct general exposition of the recent course of industrial events, and although all the agencies concerned in reducing the time and labor necessary to effect a given result in the world's work have undoubtedly acted to a certain extent and in all cases in unison, the diversity of method, under which the supply in excess of remunerative demand, or the so-called over-production has been specially effected, is not a little curious. Thus, in the case of crude iron and steel, cotton fabrics and textiles generally, coal, most articles of metal fabrication, ships, and the like, the increase and cheapened supply have been brought about mainly through improvements in the machinery and economy of production; while in the case of wheat, rice, and other cereals, wool, cotton-fibers, meats, and petroleum, like results have been mainly occasioned by improvements in the machinery and economy of distribution. On the other hand, in the case of copper, tin, nickel, silver, quicksilver, quinine, and some important chemicals, over-production, in the sense as above defined, has been almost entirely due to the discovery of new and abundant natural sources of supply. It is also not to be overlooked that other factors, which can not properly be included within the sphere of the influence of recent discoveries and inventions, have also powerfully contributed to bring about the so-called phenomenon of over-production. The increase in the consumption of some commodities is entirely dependent upon the increase in the tastes and intelligence of the masses; and it is undeniable that the culture of the

manual laborers of the world has not advanced concurrently, in recent years, with the increased and cheapened production of such articles. Many things, consequently, have been, as it were, showered upon these classes, which they do not know how to use, and do not feel that they need, and for which, therefore, they can create no market. A man who has long been contented with one shirt a week, is not likely to wish to use seven immediately, even if he can buy seven for the price that he formerly paid for one, and his wife takes pleasure in doing his washing. But the most remarkable example of this nature is to be found in the case of sugar, which takes precedence over most of the articles which enter largely into the world's commerce and consumption in respect to extraordinary increase of product, and equally extraordinary decline in price within recent years, and mainly (as will be hereafter shown) by reason of wholly artificial agencies—bounties—rather than from improvements in machinery and processes, or increased facilities for distribution.

One of the inevitable results of a supply of product or service in excess of remunerative demand (i. e., over-production) is a decline of price; and as the power of production and distribution has been increased in an unexampled degree since 1873 (as has been already shown), the prices of nearly all the great staple commodities of commerce and consumption have declined within the same period (as will be hereafter shown), in manner altogether without precedent in all former commercial history. That this experience has been altogether natural, and what might have been expected under the circumstances, will appear from the following considerations:

If production exceeds, by even a very small percentage, what is required to meet every current demand for consumption, the price which the surplus will command in the open market will govern and control the price of the whole; and if it can not be sold at all, or with difficulty, an intense competition on the part of the owners of accumulated stocks to sell will be engendered, with a great reduction or annihilation of all profit. Mr. John Bright, of England, in one of his recent speeches, relates the following incident of personal experience: "I know," he said, "a company manufacturing chemicals of some kind extensively, and one of the principal persons in it told me that in one of those high years, 1872, 1873, and 1874, the profits of that concern were £80,000, and he added that when the stock-taking and its results were communicated to the leading owner in the business, he made this very wise observation: 'I am very sorry to hear it, for you may depend upon it in the years that are to come we shall have to pay the whole of it back'; and in speaking to me of it he said, 'It is quite true, because for several years we have been able to make no dividend at all.' Well, why was that? The men who were making so large incomes at that time reinvested their money in increasing their business. Many of the concerns in this trade doubled their establish-

ments, new companies were formed, and so the produce of their manufacture was extended to such a degree that the prices went down and the profits vanished."

As prices fall and profits shrink, producers working on insufficient capital, or by imperfect methods, are soon obliged, in order to meet impending obligations, to force sales through a further reduction of prices; and then stronger competitors, in order to retain their markets and customers, are compelled to follow their example; and this in turn is followed by new concessions alternately by both parties, until gradually the industrial system becomes depressed and demoralized, and the weaker succumb (fail), with a greater or less destruction of capital and waste of product. Affairs now having reached their minimum of depression, recovery slowly commences. Consumption is never arrested, even if production is, for the world must continue to consume in order that life and civilization may exist. The continued increase of population also increases the aggregate of consumption; and, finally, the industrial and commercial world again suddenly realizes that the condition of affairs has been reversed, and that now the supply has become unequal to the demand. Then such producers as have "stocks on hand," or the machinery of production ready for immediate and effective service, realize large profits; and the realization of this fact immediately tempts others to rush into production, in many cases with insufficient capital (raised often through stock companies), and without that practical knowledge of the detail of their undertaking which is necessary to insure success, and the old experience of inflation and reaction is again and again repeated. Hence, the explanation of the now much-talked-of "periods" or "cycles" of panic and speculation, of trade activity and stagnation. Their periodical occurrence has long been recognized, and the economic principles involved in them have long been understood. But a century ago or more, when such a state of affairs occurred in any country, it was mainly confined to such country, as was notably the case in John Law's "Mississippi Scheme," or the English "South-Sea Bubble," in the last century, or the severe industrial and financial crises which occurred in Great Britain in the earlier years of the present century—and people of other countries, hearing of it after considerable intervals, and then vaguely through mercantile correspondence, were little troubled or interested. During recent years, however, they have become less local and more universal, because the railroad, the steamship, and the telegraph have broken down the barriers between nations, and, by spreading in a brief time the same hopes and fears over the whole civilized world, have made it impossible any longer to confine the speculative spirit to any one country. So that now the announcement of any signal success in any department of production or mercantile venture, at once fires the imagination of the enterprising and reckless in every country, and quickly incites to operations

which, without such a leaven of stimulus, would probably never be undertaken. The so-called cycles of inflation and depression have also undoubtedly in recent years become more frequent and intense, because the instrumentalities of production and distribution work more rapidly in effecting results than at any former period.

One universally recognized and, to some persons, perplexing peculiarity of the recent long-continued depression in trade is, the circumstance that while profits have been so largely reduced that, as the common expression goes, "it has not paid to do business," the volume of trade throughout the world has not contracted, but, measured by quantities rather than by values, has in many departments notably increased. The following are some of the more notable examples of the evidence that can be offered in confirmation of this statement:

The years 1879, 1880, and 1881, for the United States were years of abundant crops and great foreign demand, and are generally acknowledged to have been prosperous; while the years 1882, 1883, and 1884 are regarded as having been years of extreme depression and reaction. And yet the movement of railroad freights throughout the country greatly increased during this latter as compared with the former period; the tonnage carried by six railroads centering at Chicago in 1884 having been nearly thirty-three per cent greater than in 1881; and the tonnage carried one mile by all the railroads of the United States in 1884—a year of extreme depression—having been 5,000,000,000 in excess of that carried in 1882; and this, notwithstanding there was a great falling off, in 1884, in the carriage of material for new railroad construction. Again, the foreign commerce of the United States, measured in dollars, largely declined during the same later period; but, measured in quantities, there was but little decrease, and in the case of not a few leading articles a notable increase. Thus, for the year 1885, the total value of the foreign commerce of the country in merchandise was $93,251,921 less than in the preceding year (1884), but of this decrease $90,170,364, according to the estimates of the United States Bureau of Statistics, represented a decline in price. An export of 70,000,000 bushels of wheat from the United States in 1884 returned $75,000,000; while an export of 84,500,000 in 1885 gave less than $73,000,000. An export of 389,000,000 pounds of bacon and hams in 1884 brought in nearly $40,000,000; but shipments of 400,000,000 pounds in 1885 returned but $37,000,000, or an increase of foreign sales of about 11,000,000 pounds was accompanied by a decline of about $3,000,000 in price. In 1884 the United States paid about $50,000,000 for 535,000,000 pounds of imported coffee; in 1885 it imported 573,000,000 pounds for $47,000,000. In 1877, 216,287,891 gallons of exported petroleum were valued at $44,209,360; but in 1886, 303,911,698 gallons (or 87,623,000 gallons more) were valued at only $24,685,767, a decline in value of $19,683,000. But the most remarkable

example of changes of this character is to be found in the case of sugar. Thus, in 1883 the United States imported 2,023,000,000 pounds of sugar, for which it paid $91,959,000. In 1885, 2,548,000,000 pounds were imported, at a cost of $68,531,000; or a larger quantity by 525,000,000 pounds was imported in 1885, as compared with 1883, for $23,428,000 less money.

The statistics of the recent foreign trade of Great Britain, as reported to the British Board of Trade, by Mr. Giffen, also exhibit corresponding results. For example, the declared aggregate value of British exports and imports for 1883 were £667,000,000 as compared with £682,000,000 in 1873, an apparent decline of no little magnitude. But if the aggregate of the foreign trade of Great Britain for 1883 had been valued at the prices of 1873, the total in place of £667,000,000, would have been £861,000,000, or an increase for the decade of about thirty per cent.

An explanation of this economic phenomenon of recent years, namely, a continuing increase in the volume of trade, with a continuing low rate or decline in profits, may be found in the following circumstances: One constant result of a decline in prices is an increase (but not necessarily proportional or even universal) in consumption. Evidence on this point, derived from recent experiences, will be referred to hereafter; but the following example illustrates how this economic principle manifests itself even under unexpected conditions:

The price of sulphate of quinine of American manufacture in July, 1879, was $3.35 per ounce in bulk. In June, 1886, the quotation for the same article in bulk was 68 cents per ounce. Quinine is used mainly as a medicine, and is so indispensable in certain ailments that it may be presumed that its cost in 1879 was no great restriction on its consumption, and that no great increase in its use from a reduction in price was to be expected, any more than an increase in the use of coffins for a similar reason—both commodities being used to the extent that they are needed, even if a denial of the use of other things is necessary, in order to permit of their procurement. And yet, that increase in the cheapness of quinine has been followed by a notable increase in its consumption, is shown by the fact that the importation of cinchona-bark—from which quinine is manufactured—into Europe and the United States during recent years has notably increased; about 4,000,000 pounds having been imported into the United States in 1886, as compared with an import of 2,580,000 in 1883. The following statement also illustrates even more forcibly the ordinary effect of a reduction of price on the consumption of the more staple commodities: Thus, a reduction (saving) of 6*d.* (twelve cents) per week, in the cost of the bread of every family in Great Britain (a saving which, on the basis of the decline in the wholesale prices of wheat within the last decade, would seem to have been practicable), has been estimated as equivalent to giving a quarter of a million

pounds sterling, or $1,250,000 per week, to the whole people of the Kingdom, to be spent for other things.

The evidence is also conclusive that the ability of the population of the world to consume is greater than ever before, and is rapidly increasing. Indeed, such a conclusion is a corollary from the acknowledged fact of increased production—the end and object of all production being consumption. Take, for example, the United States, with its present population of sixty million—a population that undoubtedly produces and consumes more per head than any other equal number of people on the face of the globe, and is producing and consuming very much more than it did ten or even five years ago. The business of exchanging the products or services, and of satisfying thereby the wants of such a people is, therefore, necessarily immense, and with the annual increase of population, and with consuming power increasing in an even larger ratio, the volume of such business must continue to increase. And what is true of the United States is true, in a greater or less degree, of all the other nations of the globe. There is, therefore, nothing inconsistent or mysterious in the maintenance or increase in the volume of the world's business contemporaneously with a depression of trade—in the sense of a reduction of profits—occasioned by an intense competition to dispose of commodities, which have been produced under comparatively new conditions in excess of a satisfactory remunerative demand in the world's markets.

The popular sentiment which has instinctively attributed the remarkable disturbance of trade within recent years to the more remarkable changes which have taken place concurrently in the methods of production and distribution has, therefore, not been mistaken. The almost instinctive efforts of producers everywhere to arrest what they consider "bad trade" by partially or wholly interrupting production has not been inexpedient; and the use of the word "over-production," stripped of its looseness of expression, and in the sense as defined by the British Commission (and as heretofore shown), is not inappropriate in discussing the economic phenomena under consideration. It would also seem as if much of the bewilderment that is still attendant upon this subject, and the secret of the fruitlessness of most of the elaborate inquiries that have been instituted concerning it, have been due mainly to an inability to distinguish clearly between a causation that is primary, all-sufficient, and which has acted in the nature of unity, and causes which are in the nature of sequences or derivatives. One striking illustration of this is to be found in the tendency of many of the English writers and investigators to consider the immense losses which British farming capital has experienced since 1873, as alone sufficient to account for all the disturbances to which trade and industry in the United Kingdom have been subjected during the same period. That such losses have been extensive and disastrous without precedent, is not to be questioned. Sir James Caird estimates this loss

in the purchasing power of the classes engaged in or connected with British agriculture, for the single year 1885, as having amounted to £42,800,000 ($214,000,000); and as the losses for several preceding years are believed to have been equal or even greater than this, an estimate of a thousand million dollars decline in the value of British farming capital since 1880, from depreciation of land-values, rentals, and prices for stock and cereals, is probably an *under* rather than an *over*-estimate. Wheat-growing, which was formerly profitable in Great Britain, is reported as not having been remunerative to the British farmer since 1874; a fact that finds eloquent expression in the acknowledged reduction in British wheat acreage from about 4,000,000 acres in 1869 to 2,528,905 in 1886. That the agricultural populations of the interior states of Europe, which have hitherto been protected in a degree by the barrier of distance against the tremendous cheapening of transportation, are also at last beginning to feel the full effects of its influence, is shown by the statement (United States consular reports, 1886) that farming land in Germany, remote from large cities, where the demand for milk and other perishable products is small, can now be purchased for fifty per cent of the prices which prevailed at the close of the Franco-German War in 1870–'71. And yet such startling results, in the place of being prime factors in occasioning a depression of British trade and industry, are really four removes from the original causes, which may be enumerated in order as follows: *First*, the occupation and utilization of new and immense areas of cheap and fertile wheat-growing land in the United States, Canada (Manitoba), Australia, and the Argentine Republic. *Second*, the invention and application of machinery for facilitating and cheapening the production and harvesting of crops, and which on the wheat-fields of Dakota (as before pointed out) have made the labor of every agriculturist equivalent to the annual production of five thousand five hundred bushels of wheat. *Third*, the extension of the system of transportation on land through the railroad, and on sea through the steamship, in default of which the appropriation of new land and the invention and application of new agricultural machinery would have availed but little. *Fourth*, the discovery of Bessemer, and the invention of the compound (steamship) engine, without which transportation could not have cheapened to the degree necessary to effect the present extent of distribution. Now, from the conjoined result of all these different agencies has come a reduction in the world's price of wheat to an extent sufficient to make its growing unprofitable on lands taken at high rents, and under unfavorable climatic conditions; and legislation is powerless to make it otherwise. In short, the whole secret of the recent immense losses of the British and to a lesser extent also of the Continental agriculturist, and the depression of British trade and industry, so far as it has been contingent on such losses, stands revealed in the simple statement that American wheat sold for export

at the principal shipping ports of the United States in 1885 for 56 cents less per bushel than in 1874, 32 cents less than in 1882, and 20 cents less than in 1884.* "I have calculated that the produce of five acres of wheat can be brought from Chicago to Liverpool at less than the cost of manuring one acre for wheat in England."—*Testimony of* W. J. HARRIS, *a leading farmer in Devonshire, England, before the British Commission, 1886.* And what has happened in the case of wheat has happened also in a greater or less degree as respects meats and almost all other food products; increased supplies having occasioned reduction of prices, and reduction of prices, in turn, ruinous losses to invested capital, and revolutionary disturbances in old methods of doing business. The Bessemer rail, the modern steamship, and the Suez Canal have brought the wheat-fields of Dakota and India, and the grazing-lands of Texas, Colorado, Australia, and the Argentine Republic, nearer to the factory operatives in Manchester, England, than the farms of Illinois were before the war to the spindles and looms of New England.

CHANGES IN THE RELATIONS OF LABOR AND CAPITAL.—Consider next how potent for economic disturbance have been the changes in

* The average value of the wheat exported from the United States in 1885, according to the tables of the United States Bureau of Statistics, was 86 cents per bushel at the shipping ports. This was a decline of 20 cents from 1884, 26½ cents from 1883, 32 cents from 1882, 66 cents from 1874, and 61 cents from 1871.

The export value of corn was 54 cents in 1885, showing a decline of 7 cents from 1884, 14 cents from 1883, 12 cents from 1882, 30 cents from 1875, and 15 cents from 1872.

The export value of oats was 37 cents in 1885, showing a decline of 2 cents from 1884, 13 cents from 1883, 7 cents from 1882, 20 cents from 1875, and 14 cents from 1871.

The export price of bacon was 9 cents in 1885, showing a decline of 1 cent from 1884, 2 cents from 1883, 2 cents from 1875, a rise of 1 cent from 1872, and a decline of 6 cents from 1870.

The export price of lard was 7 cents in 1885, showing a decline of 2 cents from 1884, 4 cents from 1883, 6 cents from 1875, 3 cents from 1872, and 9 cents from 1870.

How closely the decline in recent years in the export prices of American cereals has been followed by corresponding reductions in the prices of cereals in the markets of Great Britain is exhibited by the following table (published in the British "Farmer's Almanac" for 1886), showing the average prices per quarter of wheat, barley, and oats, in Great Britain for two periods of ten years, commencing with 1865, with a separate estimate for 1885:

CEREALS.	Price per quarter. Average for the 10 years, 1866-1875.	Price per quarter. Average for the 10 years, 1876-1885.	Average price per quarter for 1885.
	s. d.	*s. d.*	*s. d.*
Wheat	54 7¾	43 9¼	32 10
Barley	39 2	36 5	30 1
Oats	25 10¼	22 8¼	20 7

Similar tables given by the same authority show the gross value per annum of the product of wheat, barley, oats, beef, mutton, and wool, in Great Britain, to have been £35,000,000 ($175,000,000) less in 1885 than were the mean returns for the ten years 1866–1875. According also to data given in the returns of the British Registrar-General, the average prices of beef by the carcass in the London market were £58 5*s.* 7*d.* per ton during the ten years from 1866–1875, £57 5*s.* 8*d.* for 1876–1885, and £49 17*s.* 6*d.* for the year 1885.

recent years in the relations of labor and capital, and how clearly and unmistakably these changes are consequents or derivatives from a more potent and antecedent agency.

Machinery is now recognized as essential to cheap production. Nobody can produce effectively and economically without it, and what was formerly known as domestic manufacture is now almost obsolete. But machinery is one of the most expensive of all products, and its extensive purchase and use require an amount of capital far beyond the capacity of the ordinary individual to furnish. There are very few men in the world possessed of an amount of wealth sufficient to individually construct and own an extensive line of railway or telegraph, a first-class steamship, or a great factory. It is also to be remembered that for carrying on production by the most modern and effective methods large capital is needed, not only for machinery, but also for the purchasing and carrying of extensive stocks of crude material and finished products. Sugar can now be, and generally is, refined at a profit of an eighth of a cent a pound, and sometimes as low as a sixteenth ; or in other words, from eight to sixteen pounds of raw sugar must now be treated in refining in order to make a cent ; from eight hundred to sixteen hundred pounds to make a dollar, from eighty thousand to one hundred and sixty thousand pounds to make a hundred dollars, and so on. The mere capital requisite for providing and carrying the raw material necessary for the successful prosecution of this business, apart from all other conditions, places it, therefore, of necessity beyond the reach of any ordinary capitalist or producer. It has been before stated that, in the manufacture of jewelry by machinery, one boy can make up nine thousand sleeve-buttons per day ; four girls also, working by modern methods, can put together in the same time eight thousand collar-buttons. But to run an establishment with such facilities the manufacturer must keep constantly in stock thirty thousand dollars' worth of cut ornamental stones, and a stock of cuff-buttons that represents nine thousand different designs and patterns. Hence from such conditions have grown up great corporations or stock companies, which are only forms of associated capital organized for effective use and protection. They are regarded to some extent as evils ; but they are necessary, as there is apparently no other way in which the work of production and distribution, in accordance with the requirements of the age, can be prosecuted. The rapidity, however, with which such combinations of capital are organizing for the purpose of promoting industrial and commercial undertakings on a scale heretofore wholly unprecedented, and the tendency they have to crystallize into something far more complex than what has been familiar to the public as corporations, with the impressive names of syndicates, trusts, etc., also constitute one of the remarkable features of modern business methods.

And when once a great association of capital has been effected, it

becomes necessary to have a master-mind to manage it—a man who is competent to use and direct other men, who is fertile in expedient and quick to note and profit by any improvements in methods of production and variations in prices. Such a man is a general of industry, and corresponds in position and functions to the general of an army.

What, as a consequence, has happened to the employés? Coincident with and as a result of this change in the methods of production, the modern manufacturing system has been brought into a condition analogous to that of a military organization, in which the individual no longer works as independently as formerly, but as a private in the ranks, obeying orders, keeping step, as it were, to the tap of the drum, and having nothing to say as to the plan of his work, of its final completion, or of its ultimate use and distribution. In short, the people who work in the modern factory are, as a rule, taught to do one thing—to perform one and generally a simple operation, and, when there is no more of that kind of work to do, they are in a measure helpless. The result has been that the individualism or independence of the producer in manufacturing has been in a great degree destroyed, and with it has also in a great degree been destroyed the pride which the workman formerly took in his work—that fertility of resource, which formerly was a special characteristic of American workmen, and that element of skill that comes from long and varied practice and reflection and responsibility. Not many years ago every shoemaker was or could be his own employer. The boots and shoes passed directly from an individual producer to the consumer. Now this condition of things has passed away. Boots and shoes are made in large factories; and machinery has been so utilized, and the division of labor in connection with it has been carried to such an extent, that the process of making a shoe is said to be divided into sixty-four parts, or the shoemaker of to-day is only the sixty-fourth part of what a shoemaker once was.* It is also asserted that "the constant employment at one sixty-fourth part of a shoe not only offers no encouragement to mental activity, but dulls by its monotony the brain of the employé to such an extent that the power to think and reason is almost lost."

As the division of labor in manufacturing—more especially in the case of textiles—is increased, the tendency is to supplement the em-

* The following is a reported enumeration of the specialties or distinct branches of shoemaking at which men, women, and children are kept constantly at work in the most perfect of the modern shoe-factories, no apprentices being needed or taken in such establishments: "Binders, blockers, boot-liners, beaters-out, boot-turners, bottomers, buffers, burnishers, channelers, counter-makers, crimpers, cutters, dressers, edge-setters, eyeleters, finishers, fitters, heelers, lasters, levelers, machine-peggers, McKay stitchers, nailers, packers, parters, peggers, pressers, rosette-makers, siders, sandpaperers, skinners, stitchers, stringers, treers, trimmers, welters, buttonhole-makers, clampers, cleckers, closers, corders, embossers, gluers, inner-sole-makers, lacers, leather-assorters, riveters, rollers, seam-rubbers, shank-pressers, shavers, slipper-liners, sole-leather-cutters, sole-quilters, stampers stiffeners, stock-fitters, strippers, taggers, tipmakers, turners, vampers, etc."

ployment of men with the labor of women and children. The whole number of employés in the cotton-mills of the United States, according to the census of 1880, was 172,544; of this number, 59,685 were men, and 112,859 women and children. In Massachusetts, out of 61,246 employés in the cotton-mills, 22,180 are males, 31,496 women, and 7,570 children. In the latter State certain manufacturing towns, owing to the disparity in the numbers of men and women employed, and in favor of the latter, are coming to be known by the appellation of "*she-towns.*" *

Another exceedingly interesting and developing feature of the new situation is, that as machinery has destroyed the handicrafts, and associated capital has placed individual capital at a disadvantage, so machinery and associated capital in turn guided by the same common influences, now war upon machinery and other associated capital. Thus, the now well-ascertained and accepted fact, based on long experience, that power is most economically applied when applied on the largest possible scale, is rapidly and inevitably leading to the concentration of manufacturing in the largest establishments, and the gradual extinction of those which are small. A cotton-mill which, with a profit (formerly not unusual) of a cent a yard, could easily pay ten per cent per annum on a given capital, with a reduction of profit to a quarter of a cent per yard, would have to make and sell four times the number of yards to earn the same gross profit, which even then would fall very far short of paying the former rate of percentage on the increased capital, machinery, buildings, etc., necessary to effect the increased production. Such also has already been, and such will continue to be, the outcome of railroad, telegraph, and steamship development and experience; and another quarter of a century, unless legislation interferes, will not unlikely see all of the numerous companies that at present make up the vast railroad system of the United States consolidated, for sound economic reasons, under a comparatively few organizations or companies. In this respect the existing situation in Great Britain (which corresponds to that in all other countries) has thus been represented: "Trade after trade is monopolized, not necessarily by large

* "The tendency of late years is toward the employment of child-labor. We see men frequently thrown out of employment, owing to the spinning-mule being displaced by the ring-frame; or children spinning yarn, which men used to spin. In the weave-shops, girls and women are preferable to men, so that we may reasonably expect that, in the not very distant future, all the cotton-manufacturing districts will be classed in the category of 'she-towns.' But people will naturally say, What will become of the men? This is a question which it behooves manufacturers to take seriously into consideration, for men will not stay in any town or city where only their wives and children can be given employment. Therefore, a pause at the present time might be of untold value in the future, for, just as sure as the world goes round, women and children will seek fresh pastures, where work can be found for the husband and father, in preference to remaining in places where he has to play the part of the 'old woman,' while they go to work to earn the means of subsistence."—WADE'S *Fiber and Fabric.*

capitalists, but by great capitals. In every trade the standard of necessary size, the minimum establishment that can hold its own in competition, is constantly and rapidly raised. The little men are ground out, and the littleness that dooms men to destruction waxes year by year. Of the (British) cotton-mills of the last century, a few here and there are standing, saved by local or other accidents, while their rivals have either grown to gigantic size or fallen into ruin. The survivors with steam substituted for water-power, with machinery twice or thrice renewed, are worked while they pay one half or one fourth per cent on their cost. The case of other textile manufactures is the same or stronger still. Steel and iron are yet more completely the monopoly of gigantic plants. The chemical trade was for a long time open to men of very moderate means. Recent inventions threaten to turn the plant that has cost millions to waste brick and old lead. Already nothing but a trade agreement, temporary in its nature, has prevented the closing of half the (chemical) factories of St. Helen's and Widnes, and the utter ruin of all the smaller owners. Every year the same thing happens in one or another of our minor industries."

Such changes in the direction of the concentration of production by machinery in large establishments are, moreover, in a certain and large sense, not voluntary on the part of the possessors and controllers of capital, but necessary or even compulsory. If an eighth or a sixteenth of a cent a pound is all the profit that competition and modern improvements will permit in the business of refining sugar, such business has got to be conducted on a large scale to admit of the realization of any profit. An establishment fitted up with all modern improvements and refining the absolutely large but comparatively small quantity, of a million pounds per annum, could realize, at a sixteenth of a cent a pound profit on its work, but $625. Accordingly, the successful refiner of sugars of to-day, in place of being as formerly a manufacturer exclusively, must now, as a condition of full success, be his own importer, do his own lighterage, own his own wharfs and warehouses, make his own barrels and boxes, prepare his own bone-black, and ever be ready to discard and replace his expensive machinery with every new improvement. But to do all this successfully requires not only the command of large capital, but of business qualifications of the very highest order—two conditions that but comparatively few can command. It is not, therefore, to be wondered at that, under the advent of these new conditions, one half of the sugar-refineries that were in operation in the seaboard cities of the United States in 1875 have since failed or discontinued operations.

The census returns of the United States are also very instructive on this point. Between 1850 and 1860, the number of manufacturing firms and corporations in the United States increased from 123,025 to 140,433, and the value of manufactured products increased from

$1,019,106,616 to $1,885,861,676, so that in that decade there was an increase of 17,408 establishments, to an increase of only $866,755,060 in the value of products. In 1870 there were 252,148 firms and corporations so employed, producing $4,232,325,442 in manufactured products; or an increase of 111,715 establishments in the decade from 1860 to 1870, gave an increase of $2,346,461, in the value of products. In 1880, the number of manufacturing establishments was returned at 253,852, producing articles valued at $5,365,579,191, or an addition of only 1,704 firms and corporations was accompanied with an increase of product of $1,133,537,749. Here, then, is a demonstration that the average product of a manufacturing establishment in the United States in 1880 was just sixty per cent greater than it was in 1860.

The following are other illustrations pertinent to this subject: "It is a characteristic and noteworthy feature of banking in Germany," says the London "Statist," "that the bulk of the business is gradually shifting from the small bankers, who used to do a thriving business, to the great banking companies, leaving quite a number of small customers almost without any chance to prosper in legitimate operations—concentration of capital and business in the hands of a limited number of powerful customers being the rule of the day."

The tendency to discontinue the building and use of small vessels for ocean transportation, and the inability of such vessels to compete with vessels of larger tonnage, is shown by the statement that while a steamer of from 200 or 300 tons requires one sailor for every 19·8 tons, a steamer of from 800 to 1,000 tons requires but one sailor for every 41·5 tons. In like manner, while a sailing-vessel of from 200 to 300 tons requires one sailor for every 28·9 tons, a sailing-vessel of five times the size, or from 1,000 to 1,600 tons, requires but one sailor for every 60·3 tons. And as it is also claimed that other economies in the construction of the hull or the rigging, and in repairing, are concurrent with the reduction of crews, it is not difficult to understand why it is, that large vessels are enabled to earn a percentage of profit with rates of freight which, in the case of small vessels, would inevitably entail losses.

It was a matter of congratulation after the conclusion of the American war in 1865, that the large plantation system of cotton-raising would be broken up, and a system of smaller crops, by small and independent farmers or yeomanry, would take its place. Experience has not, however, verified this expectation; but, on the contrary, has shown that it is doubtful whether any profit can accrue to a cultivator of cotton whose annual crop is less than fifty bales. "Cotton (at the South) is made an exclusive crop, because it can be sold for cash—for an actual and certain price in gold. It is a mere trifle to get eight or nine cents for a pound of cotton, but for a bale of 450 pounds it is $40. The bale of cotton is therefore a reward which the anxious farmer works for during an entire year, and for which he will spend half as much in

money before the cotton is grown, besides all his labor and time. And the man who can not make eight or ten bales at least has almost no object in life, and nothing to live on."*

The (Milwaukee) "Directory of American Millers," for 1886, shows a decrease in the number of flour-mills in the United States for that year, as compared with 1884, of 6,812, out of a total in the latter year of 25,079, but an increase at the same time in capacity for flour production. The legitimate inference from these statistics, therefore, is, that the small flour-mills of the United States are being crushed, or forced into consolidation with the larger companies. That consolidation, in this instance, has not interfered with the cheapening of product, is indicated by the circumstance that whereas the mills of Minneapolis sent out in 1881 1,200,000 barrels of flour, at an average price of $6.14 per barrel, the quantity sent out in 1885 was 1,834,000 barrels, at an average of $4.89 per barrel; and for the year 1886 the average was reported at even less.

The experience of the co-operative societies of Great Britain—the inception and practical working of which have been hopefully looked upon as likely to furnish a solution of the labor problem—as recently detailed by Mr. Thomas Hughes ("Tom Brown"), does not, moreover, seem likely to constitute any exception to the general tendency of great aggregated capital, employed in production or distribution, to remorselessly disregard any sentiment on the part of the individual workman, in respect to his vocation, and to crush out or supersede all industrial enterprises of like character that may be compelled to work at relative disadvantage by reason of operating upon a smaller scale, or inability to employ a larger aggregate of capital. This experience, as related by Mr. Hughes at a recent Congress of the Co-operative Societies of Great Britain, has been as follows: Co-operation in Great Britain, so long as it has confined itself to distribution—that is, to the purchase of commodities at the lowest rates at wholesale and without the intervention of middle-men, and their subsequent sale to members of the societies at the minimum of cost and profit—has been a very great success; but co-operation in production, so far as it has been attempted by these same societies, appears to have succeeded only by abandoning co-operation in the original and best sense of the term. For example, some of the great and most successful co-operative distribution societies of England, in order to increase their dividends, have recently undertaken to manufacture a portion of the goods which they require, and thus secure for themselves the profits they have heretofore paid to the manufacturers; and with this view, the manufacture of boots and shoes has been commenced on a large scale by two of the largest of such societies in Glasgow and Manchester respectively—the English society employing a thousand operatives, and disposing of goods to a present aggregate value of more than a million dollars

* "Bradstreet's Journal."

per annum. "These manufacturing enterprises have not, however, been conducted on co-operative lines. . . . The work-people in their factories are not co-operators. They do not share in the profits of the business. They receive simply the market rate of wages." They are on just as bad terms with their co-operative employers as they would be with individual capitalists, and they have endeavored to better their condition by entering upon strikes; or, in other words, the great Co-operative Distribution Society managers, in Great Britain, finding that it was essential to their success as manufacturing producers, have adopted, without scruple, all the methods and rules that prevail in similar establishments which have been incorporated and are managed solely with a view to the profit of their individual capitalists or stockholders."

But this is not the whole story. Besides these great wholesale co-operative distribution societies which have engaged in manufacturing, there are a large number of smaller and weaker similar societies in Great Britain which are also attempting to manufacture the same description of goods for the profit of their more limited circle of members; and these last now complain that they are absolutely unable to withstand the competition of the larger wholesale societies, which, purchasing labor at the lowest rate in the open market, denying any participation of profit to their workmen, and working upon the largest scale, are enabled to produce and sell cheaper. "So that all the disastrous effects of unlimited and unscrupulous competition, for which co-operation was expected to be a cure, are showing themselves among the co-operators, and another example is to be added to the record of modern economic experience, of the strong industrial and commercial organizations devouring the weak."

An element of international character and importance, growing out of the improvements in production through machinery, should also not be overlooked. Whatever of advantage one country may have formerly enjoyed over another by reason of absolute or comparative low wages, is now, so far as the cost of machine-made goods is concerned, through the destruction of handicrafts, and the extended use and improvements in machinery, being rapidly reduced to a minimum. For, apart from any enhancement of cost by taxes upon imports, there is at present but very little difference in all countries of advanced civilization in the cost of machinery, of the power that moves it, or of the crude materials which it converts into manufactures. The machine, therefore, which enables the labor of one man to dispense with the cheap labor of ten men, practically reduces any advantage which the manufacturer in France, Germany, or other countries, paying nominally low wages, has heretofore had over the manufacturer of England, or of the United States, to the simple difference in the cost of the labor of the operative who manages the machine in different places; and all experience shows that the invariable concomitant of

high wages, conjoined with the skillful management of machinery, is a low cost of production.

Attention is next asked to the economic—industrial, commercial, and financial—disturbances that have also resulted in recent years from changes, in the sense of improvements, in the details of the distribution of products. And as the best method of showing this, the recent course of trade in respect to the practical distribution and supply of one of the great articles of commerce, namely, tin-plate, is selected.

Before the days of the swift steamship and the telegraph, the business of distributing tin-plate for consumption in the United States was largely in the hands of one of the great mercantile firms of New York, who brought to it large enterprise and experience. At every place in the world where tin was produced and tin-plate manufactured, they had their confidential correspondent or agent, and every foreign mail brought to them exclusive and prompt returns of the state of the market. Those who dealt with such a firm dealt with them under conditions which, while not discriminating unfavorably to any buyer, were certainly extraordinarily favorable to the seller; and great fortunes were amassed. But to-day how stands that business? There is no man, however obscure he may be, who wants to know any morning the state of the tin-plate market in any part of the world, but can find it in the mercantile journals. If he wants to know more in detail, he joins a little syndicate for news, and then he can be put in possession of every transaction of importance that took place the day previous in Cornwall, Liverpool, in the Strait of Sunda, in Australia, or South America. What has been the result? There are no longer great warehouses where tin in large quantities and of all sizes, waiting for customers, is stored. The business has passed into the hands of men who do not own or manage stores. They have simply desks in offices. They go round and find who is going to use tin in the next six months. They hear of a railroad-bridge which is to be constructed; of a certain number of cars which are to be covered; that the salmon-canneries on the Columbia River or Puget's Sound are likely to require seventy thousand boxes of tin to pack the catch of this year, as compared with a requirement of sixty thousand last year (or in 1886)—a business, by-the-way, which a few years ago was not in existence—and they will go to the builders, contractors, or business managers, and say to them: "You will want at such a time so much tin. I will buy it for you at the lowest market price, not of New York, but of the world; and I will put it in your possession, in any part of the continent on a given day, and you shall cash the bill, and pay me a percentage commission"—possibly a fraction of one per cent; thus bringing a former great and complicated business of importing, warehousing, selling at wholesale and retail, and employing many middle-men, clerks, book-keepers, and large capital, to a mere

commission business, which dispenses to a great extent with the employment of intermediates, and does not necessarily require the possession or control of any capital.

Let us next go one step farther, and see what has happened at the same time to the man whose business it has been not to sell, but to manufacture tin-plate into articles for domestic use, or for other consumption. Thirty or forty years ago, the tinman, whose occupation was mainly one of handicraft, was recognized as one of the leading and most skillful mechanics in every village, town, and city. His occupation has, however, now well-nigh passed away. For example, a townsman and a farmer desires a supply of milk-cans. He never thinks of going to his corner tinman, because he knows that in New York, and Chicago, and Philadelphia, and other large towns and cities, there is a special establishment fitted up with special machinery, which will make his can better and fifty per cent cheaper than he can have it made by hand in his own town. And so in regard to almost all the other articles which the tinman formerly made. He simply keeps a stock of machine-made goods, as a small merchant, and his business has come down from that of a general, comprehensive mechanic to little other than a tinker and mender of pots and pans. Where great quantities of tin-plate are required for a particular use, as, for example, the canning of salmon or lobsters, of biscuit, or of fruit and vegetables, the plates come direct from the manufactory to the manufacturer of cans or boxes, in such previously agreed upon sizes and shapes as will obviate any waste of material, and reduce to a minimum the time and labor necessary to adapt them to their respective uses. And by this arrangement alone, in one cracker (biscuit) bakery in the United States, consuming forty thousand tin boxes per month, forty men are now enabled to produce as large a product of boxes in a given time as formerly required fifty men; and, taken in connection with machinery, the labor of twenty-five men in the entire business has become equivalent to that of the fifty who until recently worked by other methods. And what has been thus affirmed of tin-plate might be equally affirmed of a great variety of other leading commodities; the blacksmith, for example, no longer making, but buying his horseshoes, nails, nuts, and bolts; the carpenter his doors, sash, blinds, and moldings; the wheelwright his spokes, hubs, and fellies; the harness-maker his straps, girths, and collars; the painter his paints ground and mixed, and so on; the change in methods of distribution and preparation for final consumption having been equally radical in almost every case, though varying somewhat in respect to particulars.

The same influences have also to a great degree revolutionized the nature of retail trade, which has been aptly described as, "until lately, the recourse of men whose character, skill, thrift, and ambition, won credit, and enabled them to dispense with large capital." Experience

has shown that, under a good organization of clerks, shopmen, porters, and distributors, it costs much less proportionally to sell a large amount of goods than a small amount, and that the buyer of large quantities can, without sacrifice of satisfactory profit, afford to offer to his retail customers such advantages in respect to prices and range of selection, as almost to preclude competition on the part of dealers operating on a smaller scale, no matter how otherwise capable, honest, and diligent they may be. The various retail trades, in the cities and larger towns of all civilized countries, are accordingly being rapidly superseded by vast and skillfully organized establishments—and in Great Britain and Europe by co-operative associations—which can sell at little over wholesale prices a great variety of merchandise—dry-goods, manufactures of leather, books, stationery, furs, ready-made clothing, hats and caps, and sometimes groceries and hardware—and at the same time give their customers far greater conveniences than can be offered by the ordinary shopkeeper or tradesman. In London, the extension of the "tramway" or street-railroad system is even advocated, on the single ground that the big stores need quicker access to their branch establishments, in order to still further promote the economy of goods distribution.

The spirit of progress conjoined with capital, and having in view economy in distribution and the equalization of values, is therefore controlling and concentrating the business of retailing, in the same manner as the business of wholesale distribution and transportation, and of production by machinery, is being controlled and concentrated, and all to an extent never before known in the world's experience.

Keeping economy in distribution constantly in view as an essential for material progress, the tendency is also everywhere to dispense to the greatest extent with the "middle-man," and put the locomotive and the telegraph in his place. Retail grocers, as before shown, now buy their teas directly of the Chinaman, and dispense with the services of the East Indian merchant and his warehouses. Manufacturers deal more directly with retailers, with the result, it is claimed, of steadying supply and demand, and preventing the recurrence of business crises. The English cotton-spinner at Manchester now buys his raw cotton by cable in the interior towns of the cotton-growing States of North America, and dispenses with the services of the American broker or commission-merchant. European manufacturers now send their agents with samples of merchandise to almost every locality in America, Asia, and the Pacific islands, where commerce is protected and transportation practicable, and offer supplies, even in comparatively small quantities, on better terms than dealers and consumers can obtain from the established wholesale or retail merchants of their vicinity. And all of these changes have inevitably occasioned, and for a long time yet will continue to occasion, great disturbances

in old methods, and entail losses of capital and displacement from occupation on the part of individuals. And yet the world wonders, and commissions of great states inquire without coming to definite conclusions, why trade and industry in recent years have been universally and abnormally disturbed and depressed.

SLEEP AND ITS COUNTERFEITS.

By A. de WATTEVILLE, M.D.

THE Frenchman, whose long trance or sleep attracted extraordinary attention in the latter part of March and the beginning of April, was commonly spoken of as "the Soho sleeper"; but when we speak of a man "sleeping" for several days or weeks consecutively, it is obvious that we do not use the term in its ordinary sense. We all know by experience what sleep is, and we can not conceive ourselves as sleeping for an indefinite time. Yet it is difficult to draw a line between normal and abnormal sleep; the physiological condition merges by insensible degrees into all kinds of pathological states, known as lethargy, trance, stupor, coma. Through the usual phenomena of dreaming, we pass likewise into those of nightmare, somnambulism, hypnotism, ecstasy, and the like. Yet it is important sharply to define typical instances of these conditions, so as to avoid hopeless confusion in an already obscure field of scientific inquiry, and though we may for the sake of convenience occasionally use the term sleep in the wider sense, yet the distinction between the various states included under it must be kept present to our minds.

From the immense number of strange phenomena observed at the Salpêtrière Hospital in Paris, where this subject of *hypnotism*, especially in hysterical patients, has been investigated with the greatest care, and where I have had the opportunity of studying it, I shall adduce only such instances as have a direct bearing upon the case of "the Soho sleeper."

It is often possible to distinguish between a somnambulistic, a lethargic, and a cataleptic condition of the hypnotized hysterical subject; and by appropriate manipulations (all based on the theory of influencing the brain-centers by sensory impressions) to make the subject pass from one to another of these states. Supposing we have, by intently staring or by "passes," induced the *lethargic* state, we find that the muscles and nerves of the subject are in a state of extreme hyper-excitability. If we press through the skin with the finger, or a pencil, upon a nerve-trunk, all the muscles supplied by that nerve are instantly thrown into a state of violent contraction. This contraction, strange to say, may, if unchecked, persist not only during the whole of the period of lethargy, but may last for hours, or even days, after

the patient has awoke, and does not then relax even during the interval of normal sleep. On the other hand, the rigidity immediately gives way under the influence of gentle stroking of the skin over the contracted muscles.

By *catalepsy* is meant a condition of suspended psychical manifestations on the part of the subject, during which the limbs exhibit no muscular or nervous hyper-excitability, but possess the singular property, while remaining flexible, of preserving indefinitely any attitude imparted to them; hence the name of "waxy flexibility" given to this condition by old writers. Unlike the rigid spasms of the lethargic muscle, the plastic fixity of the cataleptic limb can not be relaxed by friction over the skin. The aspect of the patient in the two conditions, moreover, offers striking differences, the sleep-like immobility of lethargy contrasting vividly with the petrified attitudes of catalepsy. In both conditions, however, there often is the same absolute insensibility even to the most painful stimuli. A most remarkable phenomenon may be observed in some instances: by merely opening one eye of the lethargic patient the corresponding side of the body is cataleptized. And so in the same subject these two phases of the hypnotic sleep may coexist side by side, with the fullest display of their contrasted characteristics.

The third condition, that of *somnambulism*, may easily be brought about by light pressure or rubbing on the top of the head. The hysterical patient then passes into a state somewhat between the lethargic and the cataleptic condition. The muscles have lost the hyper-excitability of the former state, and do not possess the plastic adaptability of the latter. Still they react abnormally to light external stimuli; if we very gently stroke or blow upon a limb, it becomes somewhat rigid. We can not then relax it by a mere touch as we can in lethargy, and, unlike catalepsy, it offers some resistance when we attempt to move it into a different attitude. Insensibility to pain may persist, but there often is in the somnambulistic phase a singular exaltation of memory and of sensorial perception, which has caused it to be called the "lucid state," and which has been described by the devotees of mesmeric delusions as "second-sight." Our readers will recognize in this description the ordinary "magnetic" or "mesmeric" sleep into which not only hysterical, but many other individuals may be more or less completely plunged by the usual "passes" of operators.

It is especially in the somnambulistic state that the astonishing phenomena of *suggestion* are observed. By this we mean that the patient in whom every spontaneity is in abeyance, who does not "sleep," and who yet does not move or think, can be so impressed through some sensory channel as to enter upon some definite train of ideas or movements. He is under the control of the experimenter, whose will is his will, so to speak. He is a machine ready to go, but unable to start of itself.

There are many different ways of imparting suggestions to a hypnotized subject; and as, in the other phases of hypnotism, hysterical patients present the greatest variety of manifestations, when subjected to suggestive influences. The most characteristic phenomena are those known as "muscular" suggestions. If we analyze an emotional attitude, such as that of sending kisses to a loved person, or that of threatening an enemy with the fist and outstretched arm, we notice that the whole frame takes part in the special action. The eyes dilate, the muscles of the face move, and an appropriate play of the features accompanies the leading gesture. This collaboration of several parts of the body in the production of a common effect depends upon the existence in our nervous system of certain mechanisms subservient to the function of mimetic language or physical expression. Now if in the hypnotized subject we throw a limb into such an expressive attitude, we immediately see the usual concomitants of the movement follow suit; the trunk and other limbs fall into a harmonious posture, the carriage of the head is modified likewise, and the expression assumed by the face and eyes is so perfect as to equal or surpass the best efforts of the most consummate actor. It is difficult for any one who has not witnessed the spectacle to realize the perfection of mimicry reached by the hypnotized hystero-epileptic. The cause of this phenomenon is not far to seek: the impression conveyed by the nerves from the part placed in the attitude has called into action the whole nervous mechanism presiding over the movements generally associated with this attitude. But this is not all. Duchesne has analyzed minutely the anatomy of the expression of the human face, and by means of electric currents localized in certain muscles or combinations of muscles, imitated with great success the facial play indicative of the various emotions and feelings of the mind. Now if in our subject we likewise electrically stimulate certain muscles, and artificially produce an expression of anger, or terror, or love, or disdain, the corresponding attitude is at once assumed by the neck, arms, and body generally. Those of our readers who have access to the book will find remarkable illustrations of these phenomena in Dr. Richer's beautiful work,* for the accuracy of which all those who have had the opportunity of studying hypnotic manifestations in hystero-epileptics will be ready to vouch.

Whole series of muscular actions may be initiated by appealing to the so-called "muscular sense" by similar methods of suggestion. Thus, if a hanging rope is placed in the hands of the patient, she begins to climb with incredible energy and alacrity; when placed on all-fours, she runs in that position all over the room, regardless of knocks and collisions. Or, if the movements of washing with invisible soap be communicated to her hands, she will persist in the mimicry for an indefinite time. It is sometimes difficult to check an action so started

* "Études Cliniques sur la Grande Hystérie," second edition, p. 668.

except by waking the patient up, or making her pass into lethargy. The hypnotized patient therefore is much in the state of the frog, which when thrown into a pond, even after its brain has been removed, begins to swim on touching the water, aimlessly, automatically.

Sometimes a movement repeatedly executed by the operator in front of the patient will be imitated and carried out by the patient until stopped: this is a case of suggestion through the organ of sight. Or more complicated trains of movement may be initiated by presenting to the patient objects suggestive of certain actions, such as a plate and spoon, a brush and comb, and the like. The sight of a boot will start an endless repetition of putting it on, lacing and unlacing, taking it off, putting it on again, and so forth indefinitely.

The field of suggestions through the ear by means of language is boundless. Such words as "rats," "bird," "flower," wake up a train of imagery in the patient's brain which is immediately projected outward in an expressive display of appropriate gestures of aversion or desire, and corresponding movements of avoidance or capture. If in deep hypnotism, the subject is immediately wrapped up in those creations of the imagination; if slightly hypnotized only, repetition of the suggestive words is needed to neutralize the controlling influence of the senses. The ordinary phenomenon of hypnotism, the impossibility which the subject feels of escaping the prohibiting influence of a suggestion, belongs to this category. You assure him that he can not move his arm, for instance; he feels that he can, and yet he can not. The volitional current from his higher brain-centers is neutralized, as it were, by the current from other centers in which the suggestion has created a fixed idea of his own incapacity. As hypnosis becomes deeper, every trace of resistance disappears, and the fixed idea reigns supreme.

Such are the leading phenomena of hypnotism as observed in those highly sensitive subjects, the sufferers from the graver form of hysteria, or hystero-epilepsy. It would take us too far to describe the various symptoms of this form of nervous derangement, which, though comparatively common in France and among certain other nations, seems to be very rare, at least in its full development, among the Germanic races. In Dr. Richer's work, already mentioned, a full account is given of the appalling violence of the convulsive seizures and of the delirium that characterize the disease. Epidemics of hystero-epilepsy were rife in the middle ages, especially among the members of religious bodies; and even now it seems to be closely related to superstitions or mystical beliefs and practices.

Though essentially a disease of the female nervous organization, many instances are found of men suffering from more or less modified forms of hystero-epilepsy. The less striking symptoms of it, such as various forms of paralysis, loss of sensation, loss of speech (aphasia),

are often sufficiently developed in male subjects to justify us in classing them in the hysterical category of nerve-sufferers.

In this category "the Soho sleeper" deserves to hold a high place, as will become manifest on reading the following condensed *résumé* of his history as given by Professor Charcot, in the "Progrès Médical" for March, 1886, and completed by some further details, published in recent numbers of the "British Medical Journal":

Ch. was born in 1848, and his family history points to a strong neurotic heredity. He served in the French army in Algeria; and during the Franco-German War received a wound in the left elbow which led to amputation of the arm (1871). A few months later he was seized while at supper with unconquerable drowsiness, from which he could not be aroused. The next morning he broke out into a terrific delirium that lasted two days. A second attack of a similar nature occurred soon after. In 1875 he suffered from strange nervous symptoms, and in 1878 had another attack of sleep, followed by a long period of imperfect articulation. In 1880 he was seized again; and in addition to complete loss of speech, there was loss of feeling and movement of the left leg. He remained six months under treatment. Since then there has been a series of relapses, after one of which (1885) he came under the notice of Professor Charcot in the Salpêtrière Hospital. He was then found to have lost to a great extent sensation on the left side of the body; he could not articulate a single sound, but could express himself freely by writing. He was troubled with nightmare, in which the hallucinations of his former delirious seizures used to recur. He recovered his speech quite suddenly, without passing through a period of stammering as on former occasions.

During the fifteen months that elapsed till his arrival in London, he seems several times to have gone through his usual ordeal of sleep, followed by loss of speech and paralysis of the left leg. The attack which he has just had, seems to have been excited by the emotion he experienced on being robbed of all his money (March 24th). The somnolent stage lasted about a fortnight, and was followed with the usual paralytic and aphasic condition. During his torpor his eyes were shut, and his general appearance was that of a man in a profound sleep. He did not react to the loudest sounds; but if a ray of light was cast upon the pupil the eyelids gradually opened, and the eyeballs converged toward the bright object. The results of various experiments made upon the patient in his trance-like state illustrate several of the hypnotic phenomena already described as observed in hystero-epileptic patients. His muscles presented both the hyper-excitable and the plastic peculiarities that characterize the lethargic and the cataleptic phases respectively of artificially-induced sleep, but with the difference that they both coexisted, whether the eyes were shut or opened. Certain phenomena of suggestion through the "muscular sense" could easily be elicited. For instance, a series of movements imparted to the face, arm, or leg was automatically repeated, and continued for an indefinite time. Again, on imparting to his upper extremity an attitude of menace with outstretched arm and clinched fist, his eyes (previously opened) suddenly turned toward the limb, and he assumed an expression of anger verging on ferocity. I noticed that on interposing an opaque object between the eyes and the arm, the latter speedily relaxed and fell, the eyes closed, and the patient relapsed into his accustomed slumber.

During the second week of the trance he began to obey orders repeatedly

given, such as "Open your eyes," "Sit up," etc., and to answer simple questions by writing. He could be made to write anything to dictation; but whenever ordered to indite a letter, he constantly reproduced one he had written shortly before this attack.

Finally, he was found to have lost sensation in the left side; and the application of magnets to the skin produced some of the alterations of feeling characteristic of hysterical hemianæsthesia. Powerful electrization, though it failed to rouse him up, induced convulsions and spasms, typical of the regular hystero-epilectic seizure.

There is thus no doubt left us as to the nature of the case of "the Soho sleeper." Among other instances of attacks of sleep in the course of hystero-epilepsy, I may mention a patient whom Professor Charcot has had under his observation for many years:

She first came to the Salpêtrière Hospital in 1862, and presented many of the alterations of sensation and movement characteristic of the disorder. On April 7, 1875, she was seized with somnolency, which persisted with temporary awakenings till the 27th. There occurred then a violent outburst of paroxysmal laughter and weeping. From that moment the patient passed into a cataleptic condition, with occasional hysterical fits of the same description. She had to be fed with a spoon; she swallowed as if automatically, with a noise, but without any signs of consciousness. She awoke quite abruptly on the 7th of June, and affirmed that she had no recollection of what had taken place during the past two months. There occurred in 1876 another fit of the same kind, that lasted about a fortnight.

In order to illustrate further the intimate connection between certain morbid forms of sleep and the hysterical state, I shall briefly allude to the so-called "hysterogenic" and "hypnogenic" pressure-points discovered by Professors Charcot and Pitres.

A very remarkable phenomenon connected with grave hysteria is the artificial production and arrest of attacks by pressure on certain points on the surface of the body. The number and distribution of these points are very variable, and they differ in every case. They usually can only be found out by careful search, the patients themselves ignoring the existence of them.

On pressure being exerted upon one of these "hysterogenic" spots, the patient falls into a convulsive or tetanic spasm, and the various phases of the attack succeed one another much in the same order as in a spontaneous fit. Now it is a curious fact that a repetition of the pressure on the same spot, or on some other spot experimentally discovered, will often abruptly modify or arrest the attack. The great theoretical and practical importance of this singular property of certain circumscribed cutaneous areas, has directed the investigations of several careful observers, and led to the discovery of similar spots, called "hypnogenic," pressure upon which determines, not a muscular spasm or convulsion, but an attack of hypnotic sleep.

These hypnogenic areas are likewise irregular in their number and

distribution ; and along with them are usually found other spots, usually on the opposite side of the body, pressure upon which awakes the patient. We have here an undoubted argument in favor of the view according to which attacks of sleep in certain hystero-epileptics are mere modifications of the typical convulsive and delirious seizure.

The researches of Althaus have led him to formulate the axiom that "nervous diseases are not, as is commonly asserted, more frequent, but on the contrary less numerous, in large towns than in the country, and it is probable that their occurrence is powerfully influenced by race." He adduces a table in which the percentages of deaths from nervous diseases (as recorded in the Registrar-General's returns) for London, the southwestern counties, and Wales are 10·66, 11·20, 15·38, respectively. He has found that "Wales exceeds all English counties so strikingly in this respect that neither density of population, nor climate, nor difference of occupation will account for that circumstance." He is therefore inclined to attribute this difference to another circumstance, viz., the difference of race—a conclusion that is borne out in a certain measure by the undoubted greater prevalence of hysteroid symptoms among the Latin, and perhaps also the Slav and other Eastern races, as compared with those of Germanic origin.

It is probably in considerations of this nature that we shall find an answer to the question often asked in this country by those who do not roundly attribute all or most of the symptoms of hystero-epilepsy to shamming or exaggeration, "How is it that such cases never come to our notice?" Is it not because of those racial differences which run deep in the nervous constitution of individuals? At any rate the presence of "the Soho sleeper" among us will, let us hope, modify the somewhat insular skepticism still lurking among medical men on this side of the Channel.

The subject of prolonged sleep and trance is intimately connected with that of apparent death. Though there is no doubt that most of the dreadful tales concerning the premature burial of persons supposed to be dead have no foundation, save in the imagination of the public, we have ample proof of the possibility of such mistakes occurring in the absence of a careful examination of the body. Every one has heard of the fatal tragedy in which the greatest anatomist of his time, Vesalius, played such an unfortunate part. Being called upon, during his stay in Spain, to perform the autopsy of a patient who had died suddenly, he proceeded to open the body, when, to the horror of the bystanders, at the second sweep of the knife unmistakable signs of life were given!

It is difficult to imagine how in the case of patients subject to cataleptic seizures, and known by their friends to be so, periods of suspended animation, however protracted, could ever lead to premature

burial. Pfendler, however, states, that he has known two cases in which a disastrous result was barely averted:

A Viennese lady, who had suffered for a long time from cataleptic or lethargic attacks, was finally buried in one of her trances. The sexton, who fortunately happened to be a thief in this instance, had reopened the grave, and was busy removing her clothes during the ensuing night, when a resurrection of the dead took place. Stricken with terror, he was running away, when the woman called him back, requesting to be taken to her doctor. The second instance referred to by Pfendler is that of a young lady, aged fifteen, who, after a convulsive attack, had St. Vitus's dance and other nervous symptoms. Finally she became subject to fits of sleep lasting several days. Her health suffered greatly, and the exhaustion became such that, after a consultation of the first physicians, every hope of her recovery was given up. The next day she suddenly started as if to embrace the attendant who was watching her, and fell back as if dead. All the usual tests failed to detect any sign of life. Finally, funeral preparations were made; she was dressed in white, the bell was tolling. Still uneasy about the absence of any sign of decomposition, Pfendler was making a last examination when he detected a faint respiratory movement. After an hour and a half's friction and stimulation, movement returned; and the patient looking about and smiling said, "I am too young to die." She then fell into a sleep of ten hours' duration, and woke up in full convalescence. The patient in this case had never lost consciousness, and remembered afterward what had been said and done in the room during the medical consultation and funeral preparations.

Catalepsy, though intimately allied to hysterical neurosis, often occurs in patients who offer no other symptoms of nervous derangement. Emotions are often the exciting cause of an attack in a cataleptic subject. Many curious instances are related by authors:

A little girl, mentioned by Tissot, shocked at her sister having helped herself to a coveted morsel, remained stiff and motionless for an hour, a spoon in her hand, and her arm outstretched toward the dish. A soldier, quarreling with a companion, in a fit of passion seized a bottle to throw at him; cataleptic rigidity fixed him in this attitude, motionless, unconscious, his eyes full of anger and defiance. In another case, a magistrate on the bench, insulted in the middle of his summing up, remained as if petrified in an attitude of indignation and threat at his insulter. Again, we read of priests being cataleptized at the altar in the attitude of elevating the sacrament.

It is certain that many of the saintly women in the Roman Catholic hagiology were victims of this disease: St. Catherine of Siena, St. Elizabeth of Hungary, St. Theresa; not to speak of Joan of Arc, Madame Guyon, Marie Alacoque, and many others. Cataleptic seizures were also a common feature among the victims of the great hystero-epileptic manifestations so common in the middle ages, which we find described as "possessions" in the curious and abundant literature of the subject.

Among the sickening descriptions of the awful episodes known as "the possession of the Ursulines of Loudun," we find a graphic description of cataleptic phenomena:

The devil, enemy of Sister Claire, appeared at the command of her ordinary exorcist, Father Elizée, and rendered her supple and ductile like a sheet of lead. The exorcist bent her body in various directions—forward, backward, laterally—so that she almost touched the ground with her head. The demon kept her in the posture in which she had been placed until she was moved again, during which time she only slightly breathed through the nose and was insensible, for the father pierced a fold of her skin with a pin without drawing blood or producing pain. We also read of others who were "remarkable for their pliability. In their sleep they could be manipulated like a sheet of lead, and preserved the postures imparted to them until moved again." Elsewhere a nun possessed by the demon Cismond lay on the ground in a strange trance; her arms and legs could be twisted about as if made of wool; nothing could be extracted from her; the devil keeping her in this condition so as to prevent her confession.

Though, as already mentioned, the Latin races appear to offer a much more favorable field for the spread of nervous epidemics, we read that England has not always been free from such manifestations:

"During Wesley's sermons at Bristol," says Dr. John Chapman, in his work "On Christian Revivals, their History and Natural History," "many used to fall as if struck to the heart by the word of God. Men and women by the score were lying on the ground, insensible like dead bodies." Singular nervous accidents were likewise frequent among the American fanatics known as Shakers or Jumpers, as well as among the Irish revivalists of Ballymena.

As late as 1861, at the village of Morzine, a secluded commune in the Alps of Savoy, there occurred a curious epidemic of hysteria with all the characters of "demoniacal possession." The population of these regions is extremely neurotic and superstitious. In a short time nearly all the female population, excited by the exorcismal practices of the clergy, fell a prey to the disease, and the scenes recalled the worst days of Loudun. But at the beginning, when young girls were chiefly affected, phenomena of ecstasy, catalepsy, and somnambulism prevailed. The Government had finally to interfere, and the temporary dispersion and seclusion of the patients speedily restored their mental equilibrium, and the locality has since resumed its habitual tranquillity.

As an instance of trances of a more contemplative tendency, I shall give a short account of Louisa Lateau, of whose attacks Dr. Lefebvre has given a good description:

She used to pass into that condition without any warning. Suddenly, during a conversation, or at her sewing-machine, she would become as if transfixed, the eyes turned upward to the light. "Her expression is then one of deep attention or of distant contemplation. Her physiognomy, like her attitude, often changes, and depicts feelings of joy or of sadness. Sometimes terror is expressed, or she turns slowly, as if watching the progress of an imaginary procession. Sometimes she stands, resting on the tips of her toes, with her hands outstretched, as if to fly away. Her lips move, the eyes brighten, and her face is illuminated by an ideal beauty. The stigmata in her forehead and hands bleed.

. . . She kneels, falls face forward to the ground, where she remains for hours in the attitude of crucifixion. Other attitudes are taken during the ecstatic condition, which comes to an end in the midst of alarming symptoms of impending death."

I will, in conclusion, venture upon a few suggestions as to the explanation of the phenomena of hypnotism and its allied states.

Our cerebral life depends upon the associated activity of innumerable nerve-cells grouped into clusters or centers, each center being more directly related with some sensory or some motor function. Thus there are visual centers, auditory centers, tactile centers, which form the terminal stations of the nerve-fibers leading from the organs of sight, hearing, and touch. There are also so-called motor centers, the nervous discharges from which, traveling down to the spinal cord, determine movements of the head, trunk, and limbs.

A network of the finest nerve-fibrils of astounding complexity brings the individual cells of each center into relationship with one another, and with the cells of the other centers. This physical association of our brain-elements is the material substratum of the psychical process of association of ideas which forms the groundwork of our intellectual life. All the higher manifestations of mind are correlatives of the harmonious co-operation of numerous brain-elements. Even what appear to be simple states of consciousness are often the result of association. Hence any disturbance in the mutual equilibrium of the cerebral centers speedily leads to alterations of those resultants of forces of which perception, thought, will, emotion, are the subjective manifestations.

One of the most striking properties of the nervous system is that by which the activity of one portion may be arrested or prevented—"inhibited"—by the activity of another. To give a familiar instance, the action of the respiratory centers is suddenly inhibited by certain excitations of the sensory nerves, as we have all experienced on receiving the first splash of a cold shower-bath. In the cerebral sphere, inhibition of one tract by another is the mechanism which lies at the root of the higher exercise of our faculties. When we choose, for instance, or exercise will-power, the corresponding state of our nervous organism is one involving more or less complex inhibitions. The sense of moral effort is the subjective equivalent of powerful inhibitions of brain-tracts in a state of high tension. The power of mental concentration rests likewise upon similar inhibitions. When we attend closely to a sensory impression, or to a train of thought, the excitability of every part of the brain except that actually engaged in the act is diminished by an inhibitory action of the working portion. Thus, when we say that anger or fear paralyzes, we allude in very accurate language to the inhibitory influence which powerful emotion exercises upon the other cerebral functions.

I have said that physiological sleep can be induced by certain

monotonous impressions from without. The same may be said of an order of stimuli that has hitherto not received its due share of attention. I mean the afflux of those confused, mostly unfelt, impressions from the viscera and tissues generally. Under certain conditions—after a meal, for instance—these may set up, in the cerebral centers to which they converge, an excitation that leads to an inhibition of the higher brain-regions, and so to a state of sleep.

Similar considerations will assist us in explaining the effect of the usual methods of hypnotization. The stimulation of one of the cerebral sensory centers by repeated gentle and monotonous sounds or touches, or, in the case of the visual organs, by the convergence of the eyes and persistent gazing at a small object, so interferes with the activity of the higher centers as to lead to various perverted motor and mental manifestations. Certain "nervous" individuals, but above all hysterical subjects, are more amenable to these effects than are others. Repetition in all cases increases the liability to hypnotization, and in extreme cases the recollection of the processes previously used becomes sufficient to induce sleep. Finally, there are subjects, such as "the Soho sleeper," in whom, owing to the extreme instability of their cerebral equilibrium, a kind of spontaneous hypnotization may be observed.

It would be premature, in the actual state of our knowledge, to speculate upon the nature of the changes in the nervous system upon which the phenomenon of inhibition depends. It has been ingeniously compared to that of the mutual *interference* of two rays of light or two waves of sound. But this analogy does not account for all the facts; and in connection with this topic we may mention the views recently propounded by Professor Brown-Séquard upon what he calls nervous "dynamogeny." It is a well-known fact that under the influence of various sensorial or emotional stimuli, of moderate intensity or pleasurable quality, our nervous energy, as measured by the muscular effort we are enabled to put forth, is increased to a considerable extent. Recent researches by Dr. Féré have thrown additional light upon these "dynamogenic" or "force-producing" processes, of which the reviving effect of smelling-salts is a familiar illustration. In this instance a diffusive wave invades the whole brain from the olfactory centers, and produces such a change in its constituents as to restore its functions. It has likewise been shown that every form of mental activity is accompanied with increased nerve-power as directly measured by the squeeze of the hand on the dynamometer. It would thus seem that nervous cell-matter is liable to undergo certain modifications under the influence of various impressions derived from other nerve-regions, in virtue of which it becomes more powerful. But, without even attempting to define more closely the "dynamogenic" change, we may perhaps assume it to be the counterpart of what takes place in inhibition, and describe the latter as a nervous process in

which a group of nerve-cells so acts upon another group as to lower its capacity for work.

Inhibition in one nervous sphere is often accompanied with dynamogeny in another: the removal of cerebral influence, for instance, exalts the autonomy of the spinal cord. A good instance of the coexistence of the two processes is found in "expectant attention," which depends upon the high tension of the centers involved in anticipating the phenomena, with a corresponding inertia of the others. The reader will readily perceive how similar considerations may be employed in the elucidation of such phenomena as ecstasy, suggestion, muscular hyper-excitability, and intensified perception.—*Fortnightly Review.*

INDUSTRIAL TRAINING TWO CENTURIES AGO.

By GEORGE P. MORRIS.

AN Industrial College has just been opened in the city of New York. The State Teachers' Association of New Jersey, at its recent session, devoted some time to the discussion of the question of "Manual Instruction." Almost every one of the current magazines has monthly contributions from prominent instructors, shedding new light upon this question of the coming education. So much in order to prove the timeliness of the following reference to the past.

Thomas Budd arrived in Burlington, New Jersey, in 1678. His father was the Rev. Thomas Budd, at one time rector of the parish of Martock, Somersetshire, England, but who forsook the state Church and became a follower of George Fox, and an ardent Quaker. Arriving in Burlington, Budd immediately assumed the rank of a leading citizen in that wonderful colony of West Jersey. If any doubt the propriety of the adjective *wonderful*, let them read Bancroft's tribute to the Quakers of West Jersey, and the laws which governed and the habits which distinguished them.

In 1683 Budd and Francis Collins were each granted a large tract of land near the Falls of Trenton, "in consideration and in discharge for building the market and court-house at Burlington." In 1684, in company with Samuel Jenings, Budd went to London to confer with Edward Byllinge about the affairs of the province. In 1685 he became a citizen and merchant of Philadelphia. In 1688 his name is found among the petitioners for a bank in that city. In the great controversy between George Keith and the Quakers, Budd espoused the cause of Keith, whose intimate friend he was, and in 1694 went with Keith to England to defend him before the yearly meeting. In 1685 Budd wrote and published "a small Treatise," the title-page bearing the following peculiar inscription and dedication:

GOOD ORDER ESTABLISHED
IN
PENNSILVANIA & NEW JERSEY
IN
AMERICA,

Being a true Account of the Country;
With the Produce and Commodities there made,
And the great Improvements that may be made
by means of Publick Store-houses for Hemp,
Flax and Linnen-Cloth; also, the Advantages of a
Publick-School, the Profits of a Publick-Bank,
and the Probability of its arising, if those
directions here laid down are followed. With
the advantages of publick Granaries.
Likewise several other things needful to be under-
stood by those that are or do intend to be
concerned in the planting in the said Countries,
All which is laid down very plain, in this small
Treatise; it being easie to be understood
by any Ordinary Capacity. To which the Reader
is referred for his further satisfaction.

BY THOMAS BUDD.

Printed in the Year 1685.

Those that have generous Spirits, whose desires and
Endeavours are to bring the Creation into Order, do
I dedicate This, the first Fruits of my Endeavours.

Authorities differ as to the place of publication. It is commonly said to have been printed in London while Budd and Jenings were there upon their mission as deputies of the province. Others assert that it was one of the publications of the well-known William Bradford, of Philadelphia, and give reasons why it could not have been printed in London, and why Bradford omitted to insert his name as publisher.

In this treatise Budd describes, first, the physical features of the two provinces—East and West Jersey—the prevailing social customs; and then, after giving wholesome advice to the farmers, brewers, manufacturers, and tanners, and after outlining a scheme by which public storehouses might be built with profit to the community, and describing the ways by which the industry of flax and hemp might be encouraged, he gives his readers what he deems to be the proper system of education. His conclusion is that, if this system of education is adopted and prevails, then not only will the minds and bodies of the youths be properly developed, but the public and private coffers will be enriched. We quote so much of the treatise as deals with the subject of education. He writes:

"1. Now It might be well if a Law were made by the Governours

and General Assemblies of Pennsilvania and New Jersey, that all Persons inhabiting in the said Provinces do put their Children seven years to the publick School, or longer, if the Parents please.

"2. That Schools be provided in all Towns and Cities, and Persons of known honesty, skill, and understanding, be yearly chosen by the Governour and General Assembly, to teach and instruct Boys and Girls in all the most useful Arts and Sciences that they in their youthful capacities may be capable to understand, as the learning to Read and Write true English, Latine, and other useful Speeches and Languages, and fair Writing, Arithmatick, and Book-keeping; and the Boys to be taught and instructed in some Mystery or Trade, as the making of Mathematical Instruments, Joynery, Turnery, the making of Clocks and Watches, Weaving, Shoemaking, or any other useful Trade or Mystery that the School is capable of teaching, and the Girls to be taught and instructed in Spinning of Flax and Wool, and Knitting of Gloves and Stockings, Sewing, and making of all sorts of useful Needle-Work, and the making of Straw-Work, as Hats, Baskets, &c., or any other useful Art or Mystery that the School is capable of teaching.

"3. That the Scholars be kept in the Morning two hours at Reading, Writing, Book-keeping, &c., and the other two hours at work in that Art, Mystery or Trade that he or she *most delighteth in;* and then let them have two hours to dine and for Recreation, and in the afternoon two hours at Reading, Writing, &c., and the other two hours at work at their several Imployments.

"4. The seventh day of the Week the Scholars may come to school only in the fore-noon, and at a certain hour in the afternoon let a Meeting be kept by the Schoolmasters and their Scholars, where after good instruction and admonition is given by the Masters to the Scholars, and thanks returned to the Lord for his Mercies and Blessings that are daily received from him, then let a strict examination be made by the Masters of the Conversation of the Scholars in the week past, and let reproof, admonition, and correction be given to the Offendors, according to the quantity and quality of their faults.

"5. Let the like Meetings be kept by the School-Mistrisses, and the Girls apart from the Boys. By strictly observing this Good Order, our Children will be hindred of running into that Excess of Riot and Wickedness that youth is incident to, and they will be a comfort to their tender Parents.

"6. Let one thousand Acres of Land be given and laid out in a good place, to every publick School that shall be set up, and the Rent or incom of it go towards the defraying of the charge of the School.

"7. And to the end that the Children of poor People and the Children of Indians may have the like good Learning with the Children of Rich People, let them be maintained free of charge to their Parents, out of the Profits of the school, arising by the Work of the Scholars

by which the Poor and the Indians as well as the Rich, will have their Children taught, and the Remainder of the Profits, if any be, to be disposed of to the building of School-houses, and Improvements on the thousand Acres of Land, which belongs to the School."

"The manner and Profits of a Spinning-School in Germany, as it is laid down by Andrew Yarenton in his own words, in a book of his call'd 'England's Improvements by Sea and Land,' take as followeth: 'In Germany, where the Thred is made that makes the fine Linnens, in all Towns there are Schools for little Girls, from six years old and upwards, to teach them to spin, and so to bring their tender fingers by degrees to spin very fine; their Wheels go all by the Foot, made to go with much ease, whereby the action or motion is very easie and delightful. The way, method, rule, and order, how they are governed is: 1st. There is a large Room, and in the middle thereof a little Box like a Pulpit: 2ndly. There are Benches built around about the Room, as they are in Play-houses; upon the benches sit about two hundred Children spinning, and in the box in the middle of the Room, sits the grand-Mistress with a long white Wand in her hand; if she observe any of them idle, she reaches them a tap, but if they will not do, she rings a bell, which by a little Cord is fixed to the box, and out comes a Woman, she then points to the Offendor, and she is taken away into another Room and chastized; and all this is done without one word speaking. In a little Room by the School there is a Woman that is preparing and putting Flax on the Distaffs, and, upon the ringing of a Bell, and pointing the Rod at the Maid that hath spun off her Flax, she hath another Distaff given her and her Spool of Thred taken from her, and put into a box unto others of the same size, to make Cloth, all being of equal Threds. 1st. They raise their Children as they spin finer, to the higher Benches. 2. They sort and size all the Threds, so that they can apply them to make equal Cloths; and after a young Maid hath been three years in the Spinning-School, that is taken in at six, and then continues until nine years, she will get eight pence the day, and in these parts I speak of, a man that has most Children lives best.'"

It will be readily seen that this scheme of Budd's is very like that proposed to-day.* What are its striking features? 1. That attendance should be made compulsory. 2. It recognized that education to a great degree should be a preparation for life's struggle. Hence the boy is to receive instruction in that which would most naturally be of use to him; the girl in that which would best fit her for the duties of housewife, never for a moment forgetting the education of the mind.

* At the annual meeting of the State Board of Education of New Jersey, held at Trenton, July 12, 1887, the following resolution was passed:

Resolved, That the State Superintendent, in the interval between the present meeting of the board and its meeting in November, make a full investigation of the subject of industrial education now applied to the educational system of other States, with a plan for its adaptation to the school system of this State, and as to the desirability of its adoption.

3. It in a sort recognized, what is now known as the "elective system," be it of mind or hand, for they are to work "at that Art, Mystery, or Trade, that he or she most delighteth in." 4. The necessity of moral and religious training in public schools is asserted. Matthew Arnold has recently reiterated the necessity of this, and no doubt greatly astonished many of his readers, by asserting that he finds to-day, in the public schools of Germany, a recognition of the fitness and propriety of religious instruction and an enforcement of the same, which can not be found either in England or the United States. 5. A fostering policy by the State was urged. How? In the very way that the great public-school system of our land has been established. 6. No distinction was made between the rich and the poor, the Indian's child and the Quaker's child. With a charity that marked everything done by a Quaker, this education was to be the priceless possession of all; with the foresight which was equally characteristic of the Quaker, he prophesied that these schools would be in a measure self-supporting. In the light of to-day was this a false presumption?

Lastly, how significant is the quotation from Yarenton, who is styled by Dove, the "Father of English Political Economy"!—significant, in that it reveals to us the food upon which our colonial statesmen fed; also, because of the index-finger pointing to Germany, from which so many modern educational ideas have sprung.

Whether Budd was the first to suggest this system of co-education of mind and hand in America, we do not know. He certainly must have been among the first. Remembering that he was a colonial statesman of West Jersey growth, this fact assumes added interest, when it is recalled to mind that in all probability the first public schools in this country to establish an industrial department were those of Montclair, New Jersey, and they not until September, 1882, nearly two hundred years after Budd's treatise appeared.

SOCIAL SUSTENANCE.

By HENRY J. PHILPOTT.

III.—SPECIALIZATION.

A GREAT scientific truth is expressed in the statement frequently heard that all kinds of work tend to run into specialties. Specialization is the order of the day. The term specialty is most frequently used in speaking of those sections into which the practice of medicine has been divided; but, in reality, we are all specialists. There is no more striking difference than this between our industry and that of a tribe of savages, or of a swarm of bees. The bees in a swarm are all engaged in the same few and simple operations. One bee does not exclusively make wax and another honey. Perhaps

they would be no better off if they did ; but, for human beings, it is never doubted that specialization is a very profitable thing.

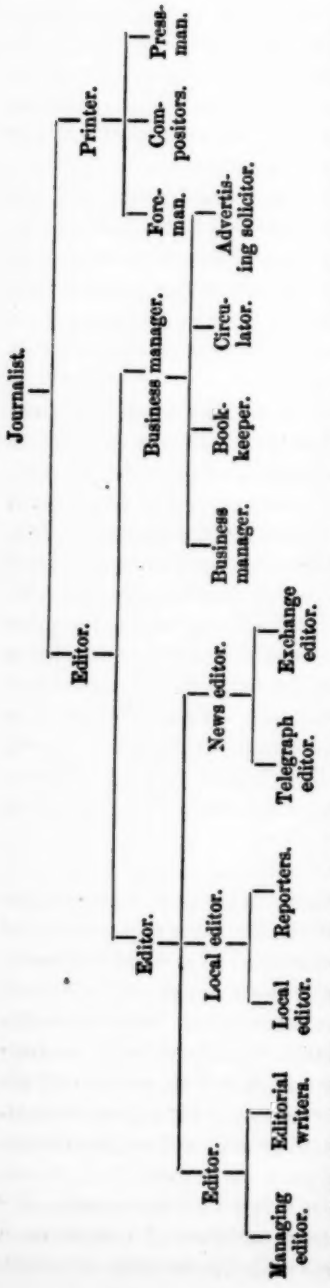
It manifests itself in two ways: 1. By the division and subdivision of existing specialties. 2. By the creation of new ones. The first is called division of labor, the second diversification of industry. It will be interesting to consider these in their order.

The practice of medicine offers us, in some respects, a good object-lesson. We talk most about specialties in medicine, for the very reason that it was one of the last occupations to be sub-specialized. Even now we have in the country, and especially in new countries, the general practitioner who attends to all the ills that flesh is heir to. He pulls teeth, amputates limbs, "doctors" the eyes and ears, and does, or tries to do, everything that all the medical specialists of a great city do. And yet his profession was itself, until within a few generations, an undivided and apparently indivisible specialty. The sub-specialties into which it has been divided may, in future, be still further divided and subdivided.

It would be interesting, if it were possible, to take some one great industry or profession, and trace out the pedigree of the specialties into which it has been divided. For an experiment in that direction, we might take the newspaper. It is now a very minutely subdivided specialty. Not only each political party, each religious denomination, each open and secret organization, but each line of business of any considerable importance, has its daily, weekly, or monthly journals devoted to its interests. And the number and variety of specialty journals are daily increasing. A list of their names would suffice for a chapter on industrial specialization. With the dates of their founding it would be a chart of the growth of the process. We should see here a process which, by reminding us of the division of the fertilized fowl's egg into feathers, bones, muscle, nerves, blood, skin, fat, etc., connects the science of political economy with all the other biological sciences.

But not only is journalism as a whole thus specialized ; the process is going on within each newspaper-office. The work is more and more divided, as the journal grows in circulation, size, and variety of contents. I shall attempt a diagram, on the plan of a royal pedigree, and it will be all the more instructive if it is not carried out to its actual limits, as exemplified in a metropolitan newspaper. Start with the original "journalist," who may yet be found in some Western county capitals, writing all his local items and general editorials, setting all his type, doing his own press-work, mailing or carrying his papers, soliciting subscriptions and advertisements, keeping and collecting his accounts—in fact, publishing the leading county paper, and "no thanks to anybody." He is the life-size presentment of "independence." He is still a specialist, but we know by the experience of others, even if we could not see at a glance, that his specialty is capable of indefi-

nite sub-specialization. Starting from him as the original "journalist," we find his work divided in a neighboring city office in a manner which may be diagrammed thus :



And this is only the beginning. If we stepped into a metropolitan newspaper establishment, we should find the work still much further divided and subdivided. A whole article would be required to describe it briefly. And the same would be true of many other industries once considered such narrow specialties that, with some reason, they were believed to have a narrowing effect on the minds of those who pursued them.

The advantages thus gained have been dwelt upon by all economists since Adam Smith. They correspond quite closely to those secured by the specializations which Nature produces all around us in the different organs and tissues of plants and animals. A good deal of tedious hair-splitting would be required to define all of them, but they may be roughly divided as follows :

I. Those that appear immediately, as the ability to form combinations of effort not otherwise possible, or not without greater waste of time or greater expense for tools. The different parts in a play must be taken by different persons. This is made necessary by the very nature of the work. In other cases the same person might attend to many different tasks, but he would lose time in passing from one to another ; and he might require a greater variety of tools.

II. Those that come a little later, like the acquired skill of the individual specialist, and perish with him. Stradivarius devoted his energies to the specialty of making violins. By doing so he gave us the best violins ever made. The fact that they have never since been equaled shows that his slowly-acquired skill died with him.

III. But the man who pursues a specialty to success often learns rules of his art which he can impart to others, or even can not help imparting, since, like the peculiarities of the general form of a violin, they remain embodied and visible in the product of his art. He invents new machines or processes which survive him and are permanently added to the world's industrial power. This advantage of specialization is the last to be realized, and is probably the greatest.

Under which head shall we place the utilization of pre-existing special aptitudes? Under the first, on the ground that part of the advantage gained from them is immediate, under the second because they are susceptible of development by exercise, or under the third on the theory that they are due to heredity? They may be a part of the legacy of past specialization. Presumably this is true in general, and particularly in the most prominent of all specializations—that which separates man's work from woman's.

This brings us to an important practical subject which we may as well pause to consider. We all want a solution of the vexed problem of woman's industrial status. She wants it vitally and primarily, and is clamoring for it. She wants to know how best to make her living. In the great scheme of mutual helpfulness which constitutes the subject-matter of economic science, she wants her best possible place, as we all want ours. And we, in turn, aside from our sympathy for her, are interested in having such industrial capacities as she possesses, and is in a position to exercise, made the most of. I have stated as a general and vital economic truth that "the better living others make the more they help us to make ours." And yet half the population belongs to a sex which feels that it is denied, either by prejudice or some other cause, or both, the privilege of making the best living of which it is capable. If this be true, the first step toward reform is to find out why it is true. If we incidentally discover, in taking this first step, that reform is difficult or even impossible, none the less must we take it; for it will save us the waste of toilsome, futile steps in wrong directions.

A painstaking inquiry into the relations subsisting between specialization, heredity and special aptitudes can not fail to furnish us a clew to some part of the trouble. We often speak of the various differences, mental and otherwise, between man and woman. Among them all there is none more striking than this, that man's work has been highly specialized, while woman's has not. True, several specialties have been evolved out of her original specialty—as weaving, spinning, baking, etc. But these new specialties have mostly been given to men, not women. To all intents and purposes woman has now, as always, one specialty—housekeeping.

Hence the intense heredity of it. It is bred in the bone. The carpenter's son may fail to develop a special aptitude for working in wood; but the son of a long line of carpenters, whose male ancestors

on his mother's side were also carpenters, would be sure to. This case never occurs. Masculine specialties are numerous. Male ancestors are also numerous. Their specialties are not one, but many. Now, if it happens that one of these ancestors had a specialty particularly adapted to transmission, which had become a part of his nature before his children were born, his posterity may have inherited his special aptitude regardless of the occupations of their immediate male parents. But, of course, it would all the time be diluted by its mixture with aptitudes inherited through other strains.

In the case of woman, every circumstance conspires to make the special aptitude intensely hereditary. It is acquired before the birth of children, hence is always transmitted. It has been transmitted, undiluted, from the female side, through countless generations. In a certain sense woman inherits masculine aptitudes from her male ancestors, But almost her only use of them is to transmit them to her sons.

In a few cases they are so strong that she yields to them and utilizes them ; and a part of her reward is that she is pointed to as an example that if women had the chance they would prove as capable as men. As a rule, girls inherit the industrial tendencies of their female rather than of their male ancestors, just as they do their voices, faces, and forms.

It is not worth while to quarrel with this fact, nor to quarrel about its original cause. It must be taken account of. From an unbroken line the woman inherits adaptation to a single specialty. From converging lines running back to a great variety of specialties the man inherits the capacity to turn his hand to many things, and measurably succeed in any one of quite a number. Woman has a "sphere," while man has spheres. How to bring about equality, or something more nearly approaching it, in this respect—the multiplicity of "spheres" —is the base of all there is in the famous "woman question." For, the moment woman has industrial potency, her way is clear to the realization of most of her other aspirations.

As compared with woman, man inherits versatility. But not all men are equal in this respect. Some inherit a larger assortment of capabilities than others, and with them the courage to abandon an adopted specialty the moment it becomes unprofitable or otherwise disagreeable, and take up another. Some whole communities have been so long tied to a single narrow industry that their inhabitants can hardly be trained to anything else. If that one industry for any reason ceases to be profitable, carried on in their way, they are comparatively helpless.

Grant that it is not good for a man to "have too many irons in the fire," or be "Jack of all trades and master of none" ; neither is it good for him to "carry all his eggs in one basket," or "have only one string to his bow." The man who is tolerably capable at several kinds of work is the better able to make his living while he is seeking

the work at which he is most capable. Many men who teach school are free to say that they do it only as a stepping-stone to something else. A great many other occupations are occasionally or generally followed for the same purpose by young men. A very large part of the world's important work is "stepping-stone" work. It implies versatility of talent.

How shall woman acquire this versatility? Her industrial predisposition is a deeply-inherited instinct. How shall she break its fetters? Not very suddenly, we may rest assured. After long waiting she has slowly begun to take up, with slowly increasing success, those masculine tasks which the never-ceasing process of specialization has placed within her grasp. She works in those factories which have taken away from her general task of housekeeping some of the duties included in it in her grandmother's time. She watches the spindle and the loom of the factory, while the wheel and the loom of her grandmother gather and consecrate the dust of the garret. She carries her inherited instinct of baby-tending into the Kindergarten and the schoolroom. She even finds employment in those of the most mechanical masculine tasks which are not too muscular. It is gratifying, as well as scientifically instructive, that in all these lines her wages are gaining on man's.

Why not divide her main specialty of housekeeping? Men have made, out of much narrower and simpler ones, whole families of specialties. This it is that justifies our treating the woman question as a question of specialization, and taking it up so early. It is not a question of capital, banking, commerce, money, production, or distribution. It is a question of specialization, and, considered in respect of the number of specialists, one of the most important, since there are more women than men in the countries of greatest economic interest.

It is worthy our close attention for another reason. It is rich in revelations of general economic truth. Not all branches of any science are equally instructive. Some plants are botanically more interesting than others. Some animals are richer than others in zoölogical phenomena, and in explanations of phenomena. Woman's work, besides being everywhere present, so that we can all study it, is a peculiarly rich field of economic investigation.

It is not by any means a narrow specialty. It is intensely inbred, but of itself it is too broad rather than too narrow. Compare the variety of daily operations of man and woman. She must be constantly turning from one thing to another. She must dust, sweep, make the beds, watch the pot, spread the table, wash the dishes, attend the baby, sew, darn, and do so many petty things that almost any shallowness or distraction of mind on her part would be excusable.

Her husband, on the other hand, is doing one thing all day. He is laying bricks, carrying a hod, heaving coal, hammering iron, watching a loom, or doing some other single and simple thing all day. If,

as some economists have feared, the minute division of labor has a narrowing and dwarfing effect on the laborer's mind, then we might expect semi-specialized woman to be the mental superior of man, unless otherwise dwarfed. For, although the metes and bounds of her sphere are more rigid than his are, within those bounds each woman must as a rule cover the whole field, while he marks out for himself a small and constantly decreasing stint, leaving the rest to others. Much of her former work, to be sure, he has taken from her; and the moment he got it he began to divide it into specialties. But enough still remains for nobody knows how many specialties. What keeps these possible specialties fast bound in one?

The family implies a home, the home a home-keeper. The family system, plus monogamy, implies one woman to one home, and no more. The appearance of two women at work in one home implies that one of them has not yet been fitted into her normal place in the monogamic family system, or has dropped out of it. She is filling a gap in her own life by a service aimed to ease and amplify the life of another. In this way the home of the well-to-do may contain several women, and in such cases they generally do divide and specialize the work. So do the women who are filling interstices in their lives by working in hotels and boarding-houses.

But taking the average woman, even in the most civilized communities, whatever of her hardest-worked female ancestor's household duties are still necessary to be done, and can not be done away from home, she must do herself alone. She must also do whatever new kinds of work the diversifying tastes of herself and family have called into being. Has she any escape consistent with the maintenance of the family system?

Are we driven to this dilemma, that either the institution of the family, which has done so much to ennoble the race, must go, or else woman's work must for all time be prescribed, like that of the slave, while man's is elective? Must the already excessive heredity of her occupation and aptitudes be still further bred in and in? If so, what manner of person will she finally be?

I confess myself unable to answer these questions to my own satisfaction. Before attempting it let me call attention to the light they throw on the nature of the science of political economy. It has been called a mental science. It has been called a moral science. It has been treated as a deductive science. It has even been treated as a matter of mathematics. Yet here, at the very outset, we find half the objects of its solicitude bound fast in the embrace of biological evolution. Their economic destiny is sealed before they are born. It is a biological fact, and as such we must study it. It is a fact not wholly psychological, nor wholly ethical, nor sociological, but physiological as well. It comes as near as anything to being omni-biological.

It will serve us no good purpose to deceive ourselves in such mat-

ters. Fine-spun optimism does not right wrongs. No tyranny was ever abolished by those who persuaded themselves that it did not exist. Delusions, like the belief in Santa Claus, may do a certain good by charming us in childhood or outside of business hours. But when we get to business, the thing we want to believe and must believe or fail, is the exact truth, no matter how unpalatable. So in regard to the status of woman we shall get no further by thinking it is either worse or better than it is, or more or less susceptible of conscious improvement. The doses of a dishonest quack are no more dangerous than those of a self-deceived ignoramus. We have all fallen into a habit of polite flattery of the nobility of woman's work. This is a convenient little bit of hypocrisy. We are very careful not to be too polite to the man or woman who does woman's work for pay. We may socially recognize the man or woman who does man's work for a stipulated salary, but not the one who so does woman's work. Woman herself, with all her kindness of heart, is just as clear of it as any of us. She always keeps the brand of social as well as industrial inferiority plainly imprinted on her inherited specialty.

Woman grew into her present economic position, and very likely she must grow out of it, if she gets out. There is no peculiar sanctity about the process of growth as compared with other economic processes. But it does need peculiar treatment in order to reach the results we aim at. We should see this quite plainly if we were called on within the same hour to advise in the case of a man with a broken leg, and a tobacco-sign which had suffered the same mishap. In most of our economic troubles there is an element of growth and an element of artificiality. With these two elements we must deal differently. And it will always help us to know in each case as it comes up, whether, and to what extent, growth predominates over artificiality or artificiality over growth. It can not hurt us to remember that an institution which was wholly artificial some hundreds or thousands of years ago, may now have reached a stage where growth enormously predominates over artificiality. In childhood, I amused myself by twisting together the two stems of a cherry-tree. The process was wholly artificial. But when the tree and I had reached maturity, its trunk was still neatly doubled and twisted, like a thread of yarn. I have often untwisted threads of yarn, but I was never foolish enough to try to untwist that tree after it had reached its bearing age. What was once wholly artificial had become almost wholly a matter of growth.

I could not even do anything to help it grow untwisted. It may be that woman and her specialty are as firmly entwined together as were the two stems of my cherry-tree, and can not be separated without injury to vitality, growth, and fruitage. They may even have to grow more and more intimately interlocked, conforming more and more to each other. If this is inevitable, we ought to know it; if de-

sirable, help it on; if avoidable and undesirable, do what we can to prevent it.

It seems to me both desirable and possible that woman should diversify her aptitudes. The process will be slow, if possible at all, but it will soon begin to bear good fruit. In those cases where she must depend on salaried work for a living, it will enlarge her life by enlarging her pay. Her independence will make her more choice in the selection of a husband, which will be a blessing not only to herself, but to her offspring. I insist on the importance of the blessing to herself, and on her right to it. If one were disposed to find fault with the order of Nature, the worst thing to be said is that there seems altogether too much vicarious sacrifice in it. A majority of the lives brought into this world are offered up on the altar of that sacrifice. The sacrificial destruction of vegetable life need give us no pain. But the animal offerings, especially the human offerings, suffer torture in the ordeal, and enlist our sympathy. The economic development of the human race has cost untold sacrificial agony, mitigated by little or no reward to those who suffer it. We can not wholly prevent this. Our best efforts to reduce it often increase it. But latterly success has come often enough to stimulate more determined trial.

First of all, then, we desire that woman, for her own sake, should secure a more commanding position in the economic world. We can have no sympathy with the wide-spread, unmanly fear that she may become a wage-reducing competitor in the masculine specialties. Neither can we sympathize with the fear that her devotion to them will make her less enjoyable as a woman. Let it make her less a woman if it makes her happier. Let it, if necessary, make her less enjoyable to man. Is it of no concern that she should be enjoyable to herself? "I am a Jew," said Shylock. "Hath not a Jew eyes? Hath not a Jew hands, organs, senses, affections, passions?" And if a Jew, why not a woman?

But even if we had a right to ask it, what right do the facts give us to believe that, in order to be attractive to man, woman must spend all her time and energies consciously trying to be so? Let those who coolly assume this to be the case, tell us how they know that man, who has little or no time for such cares, is less attractive to woman than she to him. The grimy coal-miner, without even so much as a change of clothes, manages in some way to hold with a reasonably firm grip the affections of at least one woman. As for the "oak-and-vine" idea that one half the race can be attracted only by strength, and the other half only by weakness, that will do very well for poetry and flattery, but, if it is to do for science, it must be mercilessly tested.

So far as the test has been made, the idea may fairly be said to be disproved. In fact, the result is so encouraging to the parties concerned, that the consequently growing tendency toward the enlargement of woman's sphere may well give us hope, and stimulate us to

help it on. This may be done by future inventions of machinery, or by the specialization of man's work to a point where much of it can be done by women. The dream of European economists, that through the conveyance of power by electricity the factory system is to give way to home-industry, may be realized, and woman's opportunities for sharing in a great variety of masculine tasks enormously increased. The public schools may some time be devoted more to sense and less to nonsense. Even though she must follow two or three hundred years behind man in her progress toward simplicity of dress, some of us may live to see her devoting a portion of the time now lost in that way to the cultivation, as an amateur if not otherwise, of some specialty hitherto monopolized by man. What she pursues as an amateur, her daughter, inheriting the aptitude, may find it convenient to follow for a livelihood.

Meantime, the calmness of our judgment will not be warped, though we indulge in sad contemplation of the fate yet in store for the millions of women who must be sacrificed to the good of the race, whose lives must be narrowed, whose natures dwarfed, whose care-worn minds cushed to insanity or suicide by the slowly-relaxing grip of an enslaving biological heritage. We may partially console ourselves by saying, as we did in the case of the negro, that she is born and bred to it, and can not realize how much better freedom is than enchainment. True as this may be in general, most of us do hear some complaint from the enchained. We like to hear it, because we despise the human being who has no aspiration to rise to higher things. The disagreeable feature of it is, that in the deplorable lack of economic training which woman shares with almost every man, she, like him, is disposed to attribute her troubles to the conscious intrigue or innate meanness of some class of human beings. It may be worth while to hint to her that, however irresponsible she may be, man is not responsible for her adoption of a style of dress which she would find very much in her way if she undertook to engage in some of the labors that he is free to follow. As to the willingness of her enchainment, that is a partial relief to her, but it is an obstacle to those who would break the chains. It is always harder to free a willing slave. But, when he has tasted liberty, he is very apt to like it. His callousness does not excuse the inactivity of those who have power to free him, whether or not they are responsible for his bondage. Woman's bondage is not to a person, nor to a class, so much as it is to a race—to an apparently necessary, but let us hope transitory, condition of the highest development of that race.

Turning with a sigh of relief to the economics of the sex which has hitherto monopolized the attention of the science, we find specialization hindered here, too, by circumstances over which nobody has control, or even very much influence. A large class of men, a full half of them in many countries, are in a case approaching that of woman.

The farmer's work, like woman's, may be thought of as consisting of a variety of operations which may in thought be separated. But in practice they are bound together by his isolation, by the meteorological conditions which separate seed-time and harvest, and make them both so short that the rest of the year must be filled up with other duties or wholly lost; and by other circumstances too numerous to mention. So he, like the woman, must go pottering around at odd jobs, never acquiring in any one kind of work that time-saving, nerve-saving, attention-saving proficiency which is rated by all economists, since Adam Smith, as one of the three greatest advantages of specialization. In a general way, to be sure, the farmer may have a specialty. It may be wheat, it may be corn, it may be cotton, it may be hogs, cattle, wool, horses, or what not. Whatever specialty he has, he usually gets from the nature of his soil, his distance from the market, or some inherited skill or inclination. But it is not usually an exclusive specialty. It does not furnish the whole of his employment, but only the most important part of it. In fact, it is regarded as rather a misfortune than a blessing that his soil or other environs should bind him down to any one crop. Thus, the exclusive cultivation of cotton is considered an unfortunate thing for the farmers of some of our Southern States. The loan companies, whose existence and profits depend on their making a deep and candid study of this question of agricultural specialization, are always glad to advertise to their loaning customers that their borrowing customers live in what they call an "all-crop" region. Seasons are uncertain: in the "one-crop" region the ill-wind blows nobody good; in the "all-crop" region it blows everybody some good, and the people who have money to invest in farm-mortgages think this is not wholly offset by the correlative fact that in such regions the good wind is pretty apt to blow everybody some ill.

We have now discussed the obstacles to specialization which lie in the way of about three fourths, numerically, of the population of the civilized world—one half being women, and half the rest farmers. We may now pass to those industries and professions aside from farming which must be carried on in the country, or in villages, as well as in large towns and cities. We find them less highly specialized in the country than in the city. The physician and the journalist, spoken of in the beginning of this article, illustrate the difference. It is most perfectly pictured to the eye when we walk into a country store, with its groceries, dry-goods, ready-made clothing, boots and shoes, hats, books and stationery, hardware, tinware, queen'sware, etc., and then, after a short ride on the train, go the rounds of the city shops, where all these things are separately handled.

It needs no profound scientist to tell us why. We see at a glance that density of population conduces to specialization. This is one of the ways in which it relieves its own evil consequences. World-crowding increases the necessity of our making our mutual help more

effective, but it also opens the way, so far as specialization can help us on toward that end.

But it can do so only when it crowds the world with people who have the means and the inclination to purchase the services or the wares of the specialist. A given specialty can be earlier divided into sub-specialties in a rich than in a poor community of the same numerical population. Hence, the circumstance which promotes sustenance is likely to promote specialization. And since specialization promotes sustenance, it promotes itself. It is a case of "to him that hath shall be given." It is a case where two and two make more than four.

It follows, in turn, that what promotes specialization is likely to promote social sustenance. We have spoken of density of population. Let us analyze this expression. What do we mean by saying that population is dense? The answer is extremely obvious, but for the sake of the argument let us treat it as if it needed to be given. We mean that our human beings are close together. World-crowding is the only way to get them close together in person while occupying all the soil and mines.

Nevertheless, there is another way to accomplish the same practical object. If we can not bring them together in person, we can bring their products together. We can remove the obstacles to their communication with one another. The railroad, the steamship, the telegraph, the organization of carriage and commerce, have all helped to bring people together just as effectually, in an economic sense, as world-crowding does. Facile communication has ceased to depend wholly on density of population; facile communication means facile specialization, and it also means more beneficent specialization.

World-crowding was Nature's first crude and cruel method of bringing her highest creatures together, and specializing and civilizing them. Once acquired, the habit of specialization has been facilitated and its field extended by the more kindly method of commerce. The cruel and the kindly method have co-worked to stimulate industry. Whether the cruel process will go on when it is no longer needed, and partially rob us of the fruits of the kindlier process, is a question which we may leave to the prophets and to the future. In any case, what we of the nineteenth century are permitted to witness is probably only the infancy of specialization.

Meantime, let us turn to its other form—the creation of new specialties. Much of what we have already said applies here with equal force. Still, it may be worth our while to reflect that, besides dividing up the old work, we may, by searching, find out new work. Is it likely that all the ways of catering to the wants of society have been found and utilized? There is room here for the inventive faculty. A few generations ago the now highly-specialized profession of journalism did not exist at all, even in its simplest form. It has been but a few years since the specialties of making and attending to tele-

phones were created out of nothing. To say that many other ways might be found to serve our fellow-beings and get pay for it, would be to venture into the realm of prophecy. But, if the past is any sign of the future, it is not wholly unwarranted prophecy.

We should say that in this direction there is probably work for every one of those unemployed laborers of whom we have lately heard so much. If they, or some capitalist for them, would forsake the old ruts of specialization, and, seeking some unsatisfied want of humanity, set about to satisfy it; or if, finding no such want realized, they would set about to arouse and cultivate it, they might multiply their own opportunities, increase their pay, and by relieving the labor market in the old, overcrowded specialties, increase also the pay of their fellow-workmen remaining in those old specialties.

It is often said that there is no such thing as general over-production. I am not so sure of it. I am not sure that all existing occupations may not be overcrowded, and that what is needed may not sometimes be the creation of new ones. The creation of these new ones may be the very thing that will restore equilibrium to the old ones.

A certain amount of ingenuity is, in fact, every year expended in this direction. But might not more be profitably expended? There is a limit to the fertility of the soil, and to the stores of mineral wealth; but what limit is there to the diversification of human wants? We know by the experience of all history that these wants arise and multiply naturally. We know that they may be artificially tempted into being.

Some of these unborn or unsatisfied wants might furnish profitable employments for which women would be especially fitted, and in which they could command large pay. I have no doubt the field is rich. So were the deposits of coal, iron, petroleum, and natural gas, which humanity needed so long before it had sense enough to want them or to find them. So were chemistry and mechanics as rich fields, before they were cultivated, as now.

We have to look upon humanity as a race half blindly, but with slowly opening eyes, groping after the opportunities which lie all around it. These opportunities are of two kinds. They consist not only in Nature's undiscovered resources for making us happy, but in our own ever-multiplying ways of being made happy. We have done with the old quarrel as to what is and what is not "productive" labor. We are familiar with the fine reasoning by which it is proved that the family doctor is a productive laborer because he increases our own working days and working capacity. This reasoning was needed to make him a place in the old narrow field of political economy, which included only the manipulation and valuation of material wealth.

In our wider economic field we find a place for every task by which our fellow-beings make us happy—by which they ease or amplify our lives. There is a place in it for the art, the music, the lect-

ure, the drama, the professional ball-game, whose enterprising producers have taught us to love them for their own sake, and not because they make us stronger to dig, plow, buy, and sell. We do not ask whether these things increase the harvest or fill the net with fishes. They amplify our lives, and that is enough for us. We are willing to pay for the amplification, and that is enough for the specialists who render the service.

We recognize the resources that lie in human nature, as well as those that lie in the earth. Glancing at these, we see that humanity is as blind to the opportunities offered by its own expansible and multiplicable wants and satisfactions as to those offered by Nature's unexhausted capacity to supply old wants within old lines.

We can never safely predict just how much or little, nor exactly what, can be found by searching. We might be disappointed in our search for valuable and profitable new specialties. But if a great many tried it once, we might with good reason expect more benefit than has accrued from the associations of labor and capital that are seeking to control the old ones. For while the inventor of the specialty profits by his profession or business, the customers in whom he has excited a new want are thereby stimulated to greater efforts or greater efficiencies in their own old lines, since they must have means to gratify the new want. In this way the novelties that commerce offers to those it reaches tempts contented poverty and indolence into industry and civilization. It creates in the uncivilized the wants and thereby the efforts of the civilized, and hence the German philosopher was right who said that commerce is the great civilizer.

In conclusion, among the general principles of specialization we have discovered the following:

1. That it may arise either by division of old specialties or the creation of new ones.

2. That three fourths of the population, women and farmers, are denied its highest development.

3. That heredity in specialization may be excessive.

4. That multiplication of human wants, as truly as multiplication of drafts on Mother Earth, conduces to specialization.

5. So do density of population and facility of communication.

PRESIDENT FRANCIS A. WALKER urges for industrial education in the public schools equal consideration with science and other branches, because it directs and strengthens the executive faculty, and gives scope to the creative or constructive passion; arouses interest in a larger proportion of pupils; forestalls snobbishness and dislike and contempt for manual labor; contributes to a much-needed improvement in the industrial quality of citizens; helps to quicken the sense of social decency which is manifested in keeping houses and yards neat and trim; supplies, from the girls' side, good cooks, housekeepers, and sewers; and, by the exhibition of practical results for good, makes the schools popular, and appeals to the whole community to be interested in them and maintain them.

ETHNOLOGICAL SKETCHES IN ANNAM AND TONQUIN.

THE curious philosophical views of life which appear to be common to the races of the Chinese stock, and the elaborate ceremonials by which they are symbolized and emphasized, give a rare interest to all that relates to the manners and customs of those peoples, whatever may be their particular nationality. Nowhere are these features more marked, or do they savor more of another world than ours, than in Annam. We are indebted to certain French writers, whom military and political events have given rare opportunities to observe, for some fresh and original accounts of the inhabitants of this country, and of their characteristic beliefs and usages. M. Henry M. d'Estrey has given, in the "Revue Scientifique," descriptions of the principal ceremonies prescribed in the rites to commemorate the most important events in life, which are six in number, viz.: 1. *Gèa Kê*, or the imposition of a pin in the hair-dressing of a maiden on her reaching puberty; 2. *Gèa Quan*, or the imposition of the virile bonnet on the head of a young man when he reaches adult age; 3. *Quan*, or the feast in celebration of obtaining a first employment; 4. *Hôn*, or the marriage ceremonies; 5. *Taûg*, or funeral ceremonies; 6. *Tê*, or the ceremony of ancestral worship.

The first two ceremonies are celebrated by the relatives, in the family. When a maiden has reached the age of nubility, or fifteen years, the father and mother adorn the two altars erected to the ancestors of their respective families, invite the near relatives, and select, as president of the ceremony, an aged lady, of high repute for virtue and good sense. While the lights are burning among perfumes, two masters of ceremonies, one at each end of the altar, call off the order fixed by the rites. The father and mother then come up to the altars, and say in a low tone, "It is our duty to inform our ancestors that our daughter is, according to the rites, marriageable from this day, and that the age of fifteen years, which she has reached, gives her the right to wear the pin." They then prostrate themselves four times, and the other relatives follow, imitating them. Next, the maiden is brought up to the altar, and the lady who presides over the ceremony, or sometimes the mother herself, takes the pin from off the altar and places it in the hair of the maiden, when, after having saluted the altars four times, she takes her back into the house. At any time after this the maiden may marry. The ceremony is followed by a festival, which is attended by the participants.

The ceremony of the imposition of the virile bonnet upon the young man who has reached the age of twenty years is performed with similar observances; but the father or an old man takes the place of the mother or aged lady in making the investiture.

The third ceremony takes place when a son of the family has passed the examination for the public service; for competitive examinations rule in the Annamite Government positions. The parents announce the happy event to the ancestors at their altar, and give a banquet, to which the local notables, the friends and comrades of the young man, and the acquaintances of the family, are invited.

Marriage is celebrated in different styles, according to the fortunes and conditions of the families. Mandarins, *literati*, and nobles, go through six distinct ceremonies, which, occupying months, and perhaps years, it would take a volume to describe in detail. The families frequently pledge their children to one another at a very early age. This is especially the case when parents advanced in years have young children; they then engage the children, not to force their inclination in advance, but to assure to them an honorable alliance while they are still able to make provision for them.

Marriage settlements and dowries are not recognized, on account of the difficulties that might arise in case the marriage is dissolved. According to Annamite custom, the woman should not bear the charges of marriage, because she takes the name of her husband and associates herself with him in order to perpetuate his family, not for the sake of her own. It is just for the husband, in his own personal interest, to furnish all that she and her children may need; yet, according to another custom frequently followed, the suitor whose character is not well known should make several visits to the family of his affianced, so as to submit himself to a kind of testing often very severe, which shall permit his value and the amount of his knowledge to be rated. This stage of the negotiations sometimes lasts for several years.

Marriage is usually contracted by inclination, without money considerations entering into the matter. The family is regarded as a moral union, and not as a business association. Hence it is common to see a wealthy family allied with a poor one. It is considered that, when a man marries a girl without fortune, but wisely brought up, she will be easily touched by the care he will take of her, and be obedient to his authority. Then, it is not right to exact a dowry from a girl whose education has already imposed on her parents large sacrifices of time and money, and who has, moreover, abandoned her family name to take that of a stranger, so there is no dowry. The parents give their daughter what they please, without the young man being allowed to claim or stipulate for anything. Sometimes they require him to make considerable presents, which will be the sole property of the wife. It must not be supposed that the condition of wives is the same in Annam as in China. The six ceremonies of marriage are, it is true, nearly the same in both countries; but while the Chinese wife has to keep to her apartments, the Annamite wife is treated as the equal of her husband.

This equality is revealed both in the division of authority and in

the matter of honors and distinctions. When a man, in consideration of his having rendered great services to the Government, or done a good to the people, obtains a decoration, like insignia are conferred upon his wife. The legislator appears to have thought that a husband would not have had leisure to consecrate himself so closely to the defense of the public interests, if his wife had not been faithful and devoted; if by attending to the orderly direction of his household, she had not relieved him from the care of his personal interests, and left him in full liberty of mind. Women can also obtain official rewards, when, having become widows, they keep faithfully the name of their husbands, and distinguish themselves by the manner in which they bring up their children and administer the estate which the father has left them. The emperor then decrees them a framed diploma, which they hang in their house, and on which, by the side of their name, figures the mention of their virtues.

The duties of the married woman consist in the cares required for the well-being of her husband and children, and the becoming reception of relatives and friends. She has the preparation of the festivals for the ancestral anniversaries, taking precedence in this case of her husband's sisters, by virtue of the rights which her title of legitimate wife, member of the family right, gives her upon the administration of the domestic cult. The interior management of the house belongs to her exclusively. She has full control over the servants, and supervision of the expenditures and receipts. Although invested with such extended powers, the Annamite women have the additional merit of being submissive, patient, and little inclined to coquetry. They spend but little for dress, and the caprices of fashion are unknown to them. When they attend any ceremony or visit relatives or friends, they wear the dress and jewels which their husbands gave them as marriage presents. When jewels are bought in rich families, they are not intended to be worn by the purchasers, but to be reserved for the marriage presents of the children.

Balls are regarded by the Annamites as scandalous affairs. It is contrary to the rites for men and women to take one another's hands unless they are relatives or friends. According to the philosophers, the male element tends to seduction and the female element to levity; their contact in familiar interviews could therefore be only a temptation to innocence. It is for this reason that the affianced man is not allowed to make his court to the woman. Although the theatre is supposed by the Annamites to exhibit good manners in action, it is usually attended only by men and elderly people. Girls go occasionally, but always accompanied by a member of their family.

The education of the children begins even before they come into the world. The prospective mother is at once submitted to a kind of material and moral *régime* sanctioned by custom. Gross viands are removed from her table, and her slightest movements are regarded,

that they may be regular and majestic. She is expected to listen to the reading of good authors, to music and moral chants, and to attend learned societies, in order that she may fortify her mind by amusements of an elevated character. And she endeavors, by such discipline, to assure to the child whom she is about to bring into the world, intelligence, sagacity, docility, and fitness for the duties imposed by social life. In confinement ladies are attended, not by the ordinary doctors, but by women especially devoted to the calling, who regard their profession as honorable and humanitary. The birth of a child is signalized, especially in the country, by setting up in front of the house a bamboo stick, in the tip of which is inserted a half-burned piece of wood. A glance at this stick is enough to tell the sex of the child. It is a boy if the burned end is turned toward the house; a girl, if the black is turned in the other direction. The arrangement is symbolical, is of an origin that is lost in the darkness of the past, and signifies that the son will some day succeed his father in the government of the family, while the daughter will leave the paternal mansion to enter, by marriage, a strange one. It is customary to give the child a year on the day of its birth, and a second year on the first day of the succeeding calendar year. Thus a child born on the 30th of December, 1886, would have been counted as of two years on the 1st of January, 1887. This way of counting ages makes the first day of the year a day of general festivity, for it marks for every one, no matter what may have been his real birthday, one year more, and thus represents a common anniversary. A month after the birth the family gives a festival, to which the relatives and friends are invited. An elderly person, man or woman, according to the sex of the child, who must also be of good repute and well instructed, is chosen to give the child its particular name and transmit to it the first notions of things. In this ceremony, called *M'ach-Miêng*, which accompanies the festival, the person who presides passes a ruler several times before the mouth of the child, pronouncing some consecrated words; then, with a freshly-plucked flower, he sprinkles pure water over its head and body: this symbol signifies that the child, when it has become master of its actions, will take just reason for its guide, and will guard itself against contaminations and vices. Another ceremony, of an entirely different character, takes place a little later. It is called *An-Thoi-Noi*, which means leaving the cradle. The parents bring the child before the altar of the ancestors and present their youthful descendant to them. They then place it among a collection of objects appertaining to various trades, and let it choose the one toward which its instincts draw it. Its choice, directed by the spontaneous aspiration of a virgin mind, will indicate the way which it is some day to follow. This ceremony, which is of ancient origin, is, however, nearly abandoned now. The child is given to the care of the nurse only when the mother is prevented by sickness or some other serious cause from nursing it herself.

If the child is a daughter she is intrusted, when she has become of suitable age, to the care of a discreet and virtuous woman, who attends to her education in the house, under the eye of the mother. The education and instruction of the daughters are considered of prime importance. It is the first condition of the prosperity of the family, who can not possess a more precious treasure than a competent woman, respected by all, orderly ruling her house, bringing her children up in virtue, and wisely directing a numerous personal establishment. The instruction of girls includes the rules of deportment and politeness, reading, writing, and arithmetic; music and literature; weaving and needlework; the culinary art, and all the various matters which it is important to know in the management of the house. So, when we notice that the heads of the family are elegantly clothed, that the table is well served, and that order and good taste prevail in all the details of domestic life, we at once discern the presence and the judicious activity of a well-trained and accomplished daughter.

The boys are also brought up in the family; but they are taught in the public schools, where they attend during the day only. It is usually judged best to seek instructors for both sons and daughters outside of the family. The parents consider themselves disqualified for the exact discharge of the teacher's work by the strength of their affection, and too likely to err in the direction of over-indulgence, or in the opposite one of undue strictness.

A more circumstantial account of the celebration of the New-Year's festival, referred to above by M. d'Estrey, is given by another French writer, M. Gouin, in the "Bulletin de la Société de la Geographie." In honor of the anniversary, the Government offices and more important business establishments and enterprises are closed or suspended from the fifth day preceding to the fifth day afterward; but the poor need take a vacation of only twenty-four hours. All is silent and still in the town, except for the firing of shooting-crackers and the going about of the people dressed in their best and carrying presents, on their visits of ceremony. On the eve of the festival a green bamboo is planted in the court-yard by way of invitation to the ancestors and deceased relatives to come and partake of the repast which has been prepared for them. A flag-staff is set up at the front door, adorned with palm-leaves, feathers, etc., to which a lantern is hung at night. Within the house the disposition of the furniture has been entirely changed, and everything is given a holiday look. Bows and arrows are chalked on the ground at the entrance to keep bad spirits away, and sometimes the door is further obstructed by abattis of thorn-plants. A little square niche on one side of the wall without is reserved as an altar in honor of the genius of the quarter, on which offerings of burning torches, incense, flowers, meats, and gilded papers are made, with the firing of crackers by the bunch. The ancestors may be attending the feasts at any time. During the last three days

of the ceremonies, their tombs are cleared of weeds and given the repairs which their condition may require. A long lacquered table is set in the principal room, and above it a large red tableau, on which are represented various personages, flanked by characters and sentences enumerating the qualities that distinguished them or those which they would have liked to have. On the table are placed a variety of offerings to the spirit of commerce, who is invoked to bring prosperity. The place of honor, which usually looks upon the door, and the most generous offerings, are given to the ancestral altars. The grand repast takes place at midnight on the 30th; and as a result of what goes on then, the Annamites, usually sober, begin the year in a very drunken condition. In connection with this feast, a quantity of last year's water is compared by weight with the same quantity of the water of the new year. If the latter is the heavier, it is a bad sign, and inundations may be expected; if lighter, the air of the new year will be pleasant, and the rivers will flow placidly. At the final repast, on the 4th or 5th of the new month, the departure of the ancestors, who are supposed to have been present at all the ceremonies, is celebrated with the burning of gold and silver papers. The houses are not opened after the festival for the resumption of business if the weather is bad; for the sun must be the first to enter them, or something unpleasant might happen.

M. d'Estrey, continuing his account, observes that there are no public cemeteries in Annam. Every person seeks for a suitable place of his own in which to bury his relatives. Not rarely families keep the coffins of their relatives—very solid and tight structures of wood—in their houses even for a considerable time. Poor persons are sometimes buried in grounds given by the more wealthy for that purpose. Mourning is worn in white. Its duration is fixed according to the nearness of relationship; for father and mother, three years; for grandparents, brothers, and sisters, one year; and so on. Persons who are in mourning must not appear at public spectacles or dress elaborately, or indulge in any gayety. After the mourning has terminated, a family festival is celebrated at each anniversary, when a repast is offered upon the ancestral altar. The formal visit to the tombs, the keeping of them up, and the duty of attending to the rites of ancestral worship, appertain to the heads of the family, the other relatives only following their orders in the matter. After reaching fifty or sixty years of age, parents who have children large enough to attend to affairs leave the general direction of their houses to them, and devote their attention to giving honors to their ancestors. The cost of ancestral worship in Annamite families is lighter than the cost of church services in France. The heads of families are themselves priests, and have only to say a brief ritual on the occasion of the anniversary of the death of each member of the kindred. Besides the special family altars to each ancestor, there exist temples consecrated to all the mem-

bers which the same kindred has counted in the past. At a designated day, all the members of the family present themselves there to make their sacrifices. The ceremonies are directed by the nearest or most aged relative. The character of the offerings depends upon the tastes the ancestors are supposed to have had while living. No pictures or statues of the ancestors are erected to preserve their features; only the name is to be seen on the altar, inclosed in a little tabernacle and written in large letters upon a tablet. The image of the ancestor is in the Annamite's heart, and is not represented materially by painting or sculpture. It is not presumed that the souls of the ancestors are present at the repast which is prepared for them; but it is understood that, in offering sacrifices to them, gratitude is expressed for the time when the worshiper was the object of their constant solicitude, and faithful recognition is given of the days when he was held upon their knees, and the painful moment is recalled when they were forever separated from their children. Filial piety is the motive of all the acts of the Annamites' life. Their feeling was thus described to M. d'Estrey by an Annamite: "We have a desire to discharge the debt that we owe to our parents; to that tender mother who carried us in her womb, who brought us forth in pain, nourished us with her milk, and caressed us on her knees for years; to that watchful father who laboriously brought us up and constituted himself our first guide in the labyrinth of the world. It is a common remark that every service rendered ought to be recompensed. The benefaction by which it is given us to enjoy life, to know what is, to raise ourselves through the spectacle of the virtue of our parents, from the simple creature to the most high—what other can be compared to it? It is for this reason before every other one, to render ourselves worthy of our parents, to make their name as illustrious as possible, that we try to obtain a rank among men that shall do honor to our house, and in which we may some day serve the great interests of humanity. We hope that in this way the spirits of our parents may enjoy a peaceful happiness in contemplating us from the celestial world."

M. Mahé de la Bourdonnais has given an account, also in the "Revue Scientifique," of tribes of people inhabiting portions of Annam, who, although considered savages by the Annamites themselves, are still possessed of a civilization which is of the greatest interest.

Some of them pay tribute to the King of Siam, others to Annam, while all are more or less under the control of certain prefects. A chief, whom they regard as a father, acts as judge, punishes the guilty, and vigilantly guards the observation of the ancient rites and ceremonies. Much respect is shown to these patriarchs, and their people aid them in building, labor in their fields, and yield implicit obedience to them. The wives of the chiefs generally marry one of their own rank, but this is not compulsory. If they marry beneath them,

they lose their claims to nobility, and are fined for not having retained their rank.

When, as frequently occurs, the chief does not live in the village, of which he is the head, his place is filled by one of the nobles, who, acting under the orders of the chief, attends the deliberations of the council, furnishes the requisite number of men for the husbandry service, and communicates the wishes of his master to the people.

The religion of all of these tribes is one of fear: a constant offering up of sacrifices to propitiate evil spirits. Famine, plague, sickness, and misfortune are supposed to have their origin with them. They preside over all things, and govern at will. The waters, the forests, each tree, each mountain, is inhabited by spirits; even the villages are supposed to be governed by them. Hence, they build huts at the entrances to their towns wherein these guardian spirits may dwell, and yearly sacrifices, consisting of various animals, are offered up to them, lest the harvest fail. Sacrifices are also made when one of their number is sick, in order to drive out the evil spirit, or at least to appease it. Their house-spirit is the only one for which they have any respect, as they imagine that their ancestors from time to time re-visit them, and a small table in one corner of the room is always reserved for them. At certain solemn occasions this table is saluted by them with the greatest respect. As a general rule, however, these people care very little for their gods, excepting in time of danger and misfortune.

The huts of the principal tribes are constructed of wood and built upon piles. The walls are of braided bamboo, made in such a manner that, even when the windows and doors are closed, there is little difficulty in reading and writing within, the poor braiding allowing the entrance of light. The roof is also made of bamboo covered with palm-leaves. Not a single nail or pin is used in the construction of these houses. When a new one has been completed, the head of the family makes grand preparations to properly celebrate the event, according to his means. Oxen are killed, wine is drunk, pipes smoked, and there is general rejoicing on the part of the family and its guests. Intoxication, however, is rarely met with on these occasions.

The interior of the hut corresponds in simplicity with its exterior, In order to gain admission it is necessary to first climb the ladder suspended from the door; before entering the feet are bathed in a long bamboo tube filled with water, as shoes are but little worn. As there is no outlet for the smoke arising from the fireplace, excepting through the roof and the crevices at the sides, the room is constantly filled with it. Three large stones serve as a tripod. Shelves containing rice, salt, and other articles of food are ranged about the room. Knives, hatchets, and the indispensable bamboo tube containing fresh water, are conveniently placed. On what may be considered the ground-floor, fowls, pigs, and other domestic animals make their home.

Rice is the principal food, and they obtain a very delicate flavor by steaming it through a bamboo tube. Smoking is indulged in to a considerable extent.

These people are, generally speaking, somewhat careless, apathetic, and without fear for the morrow. Hence, they live in a sort of hand-to-mouth fashion, confining themselves to the cultivation of the narrow strips of land at the foot of the mountains. The fields are very small, and water is frequently brought to them by means of canals. The men work the fields with a light plow, but often dispense even with that, and use a harrow, the teeth of which are made of bamboo. Ordinarily there are two harvests, excepting in certain districts, where the winters are too severe.

The men rise at daybreak at all seasons of the year, smoke their pipes, lounge about the house for a time, then work in the fields until about ten or eleven o'clock, when they return for breakfast. A short sleep is then indulged in. The afternoon is spent in roaming about the mountains, fishing, hunting, or gathering bamboo. The evening is passed at home. At about eight o'clock the only other meal of the day is partaken of. Their dress resembles that of the Annamites.

The women here, like those of most other wild tribes, are the real laborers. They pound and gather in the rice, bring fire-wood from the mountains, spin cotton, make cloth, prepare the meals, and, in a word, do almost all that is to be done. Each member of the family, however, works at his or her pleasure. The result of this freedom is a lasting friendship between the members of the same family, and frequently the children, even after marriage, will remain under their parents' roof; thus, three or four families are often found living together in perfect harmony. The women are usually very poorly dressed, and make a less agreeable impression than the men.

Great affection is shown toward their children, so much so that paternal authority is apt to suffer. When a child is born, a string is suspended near the mother and the infant to prevent the devil from carrying it away. Bits of rice are also put into the child's mouth with the words: "If thou art of the devil, let the devil slay thee; if thou art of Heaven, let Heaven protect thee."

Marriage does not take place until the men have reached the twenty-fifth year, as it is necessary to have a considerable sum of money for the bride's parents before the event can take place. The fathers and mothers manage the affair almost entirely themselves. Three visits are made between the parents of the contracting parties; on the fourth, the bridegroom accompanies his parents, carrying the money, a pot, a pig, and a jug of wine. He invites the parents of his future wife to feast; they furnish a pig and a jug of wine also, and the two families make their repast in common. A chicken and an egg are now prepared; each is cut into two equal parts, wishes for their future happiness are expressed, and the couple invited to eat.

They drink wine from the same jar, and are both seated upon one mat; congratulations are renewed and another feast spread, this time at the house of the groom's parents. This concludes the ceremonies.

Cases of sickness are generally treated by the application of roots, herbs, and leaves; each family possesses certain preparations, whose composition is kept secret. There are no physicians, and they apply their own remedies.

When any one of their number dies, friends and neighbors hasten to the mountains, hew down a tree, hollow it out, and, after having washed and dressed the body, put sugar-cane into its mouth, and invoked the shades of the dead, place it in this rude coffin, open the eyes so as to look heavenward, and then carefully seal it up. On the day of burial, sacrifices are indulged in, according to the means of the relatives of the deceased. The grave is usually made in a forest, and the hewing of trees therein is superstitiously avoided. A soothsayer, or priest, plants two reeds at the borders of a stream in such a manner that the parents of the dead can pass underneath; while doing this, he sprinkles water upon them which had been used to clean rice. After washing their clothes and cutting their hair, they enter the house, and, in order to show the depth of their sorrow, throw everything about the house into confusion. The priest arriving, he reproaches them, restores order, and sprinkles a kind of holy water in order to drive out the evil spirits.

The language of these tribes is a mixture of the Annamite and Chinese. It is chanted in a manner peculiar to the former, but differs somewhat in sound. Thirty-six letters comprise the alphabet, a peculiarity of which is that there is no letter corresponding to our *r*.

CORK, ITS MANUFACTURE AND PROPERTIES.

By ARTHUR GOOD and WILLIAM ANDERSON.

A CONSIDERABLE number of trees, including the cherry, birch, elm, plane-tree, and maple, produce a corky substance in their bark, but in too thin layers to admit of economical use. In Brazil, the bark of a tree of the family of *Bignoniaceæ*, and the pith of *Pourretia tuberculata*, of the family of *Bromeliaceæ*, furnish a kind of cork, as does also the *Euphorbia balsaminifera* of the Canary Islands. But none of these substances is capable of any important use.

Two varieties of oak, the cork-oak (*Quercus suber*), which grows in the Mediterranean basin, and the Western oak (*Quercus occidentalis*) of Gascony, share the monopoly of the production of cork in thick-enough sheets to be utilized. But the natural cork which they furnish, and which is called male or virgin cork, has, whatever its thickness, but slight commercial value; and it is not employed industrially

till it has been improved by cultivation. An article of cork, a bottle-cork, for example, is therefore doubly an industrial product: first, as a substance, the qualities of which have been brought out by perfected processes of cultivation and harvesting; and, secondly, as an article that has been manufactured, either by the hand of man or by a machine. It will hence be profitable to study the processes of cultivating and gathering the cork, and the various industrial applications to which the substance lends itself—subjects concerning which no well-composed account has yet been given.

The bark of the cork-oak is composed of two distinct concentric layers: an inner sheet, which is the active part of the bark, and corresponds with the liber of other trees; and a thicker, outer zone, composed of light, compressible, spongy substance, only slightly permeable to liquids, and constituting the cork proper. Wherever upon the body of the tree the inner sheet, or "mother" bark, is destroyed, no further formation of bark or wood takes place; and even a narrow decortication clear around the tree would cause it most certainly to perish. The other coat, or cork, is inert, and does not contribute to the active functions of vegetation; and this explains how it is possible to strip the cork-oak of its corky envelope without endangering the existence of the tree. The inner bark, moreover, if left untouched, will form yearly new layers of cork which may ultimately, when they have become thick enough, be removed in their turn, and furnish the cork of commerce, also called female cork.

According to the most excellent account of the process, given by M. Matthieu, in his "Flore forestière," the *demasclage*, or removal of the cork, is done in July or August, when the condition of the sap-movement permits an easy separation from the "mother." The work must be suspended when the winds of the sirocco are blowing, for they would destroy the vitality of the inner bark by drying it up immediately; and about two per cent of the trees are likely to be lost, if the operations are crudely performed, by exposure to the glare of the sun. The renewed young bark, if it is permitted to form itself in contact with the air, is also exposed to the attacks of insects and liable to become cracked. To obviate these disadvantages, M. Capgrand Mothes, a French sylviculturist, has devised a method of clothing the stripped oak-trees, by replacing and leaving upon them for a while the cork-bark which has been taken from them. Having been removed in the shape of two half-cylinders, it is easily tied back upon the trunk with wires, while the joinings are covered with strips of paper. The dress is taken off at the end of three months, when the cork which has been utilized to compose it will be found to have become better seasoned than it would have done by the usual method of stacking it. The new bark, under this protection, will have formed only a thin, superficial crust, and that free from cracks and the marks of insect-stings. This process, which furthermore protects the trees against hot

winds and insolations, has the additional advantage of expediting by a year the time when the next crop of cork will be fit to gather in.

Before being put into the market, the bark has to be subjected to the operations of steeping, scraping, sorting, and packing. The object of the steeping, which is performed in large boilers of water, heated by means of chips of the bark, is to swell the cork and increase its elasticity, and it has the further effect of enabling curved pieces to be made straight. Scraping, for the removal of the woody parts, is done with iron scrapers, or with a machine in which the rotating chisels make nine hundred turns in a minute. It involves a loss of twenty-eight per cent of the crude bark, but is not so necessary when the formation of the young cork has been protected in the manner that we have described. In England, these two primary operations are replaced by a process of scorching and brushing the bark. The sorting is done with reference to five degrees of thickness, after which the bark is packed in bales containing about two hundred pounds each. At the market it undergoes another testing for quality, in which there is a wide range, and a corresponding diversity of prices. According to M. Lamey, in his book on "The Cork-Oak in Algeria," the bark should never be gathered till it is seven eighths of an inch thick, and that is preferred in commerce which is from one and an eighth to one and a quarter inch thick. To produce such thickness, from six to nine years of growth are needed.

The density of cork varies with its quality and age. Thin corks are usually heavier than those of the same volume that have grown more rapidly, and, in corks of the same class, the density increases with the age. M. Brisson gives 0·240 as an average maximum, and the ordinary density of a ten-years-old cork may be taken at 0·2. With extreme lightness are associated other valuable qualities: that of being a poor conductor of heat and sound; impermeability to liquids; imperfect combustibility, and non-liability to decay, by reason of which it is susceptible of very numerous applications in industry. The most important use of the substance is for bottle-corks. The bark which is intended to be used in this form is kept in a damp cellar. When taken to the shop, it is cut by the first workman into strips, the width of which corresponds with the length of the future cork. A second workman cuts these strips into squares suited in size to its diameter. The squares, strung, are plunged into boiling water to make them swell out. They are then stored in a cool place, and kept constantly moist by sprinkling, till they pass into the hands of the cork-maker. He applies them in succession, giving them a rotary motion, to the edge of a wide-bladed knife, drawing them at the same time slowly along its length, and by skillful manipulation transforms the square into a round cork. This is the method usually practiced in France. Workmen in other countries handle the knife in different manners. It is essential, to obtain a good and solid cork, to take care

that its axis, as it is cut from the bark, be parallel with the axis of the tree on which the bark grew ; but the broad, flat corks have to be cut perpendicular to the axis of the tree. Only the finest corks are now made by hand. A good workman can turn out, in the method described, about one thousand corks a day.

We give representations of three machines invented by Demuth, which are so simple in their operation that any one can make corks upon them at the first trial. The first machine cuts the cork into strips (Fig. 1) ; the second into squares—eight thousand a day with a

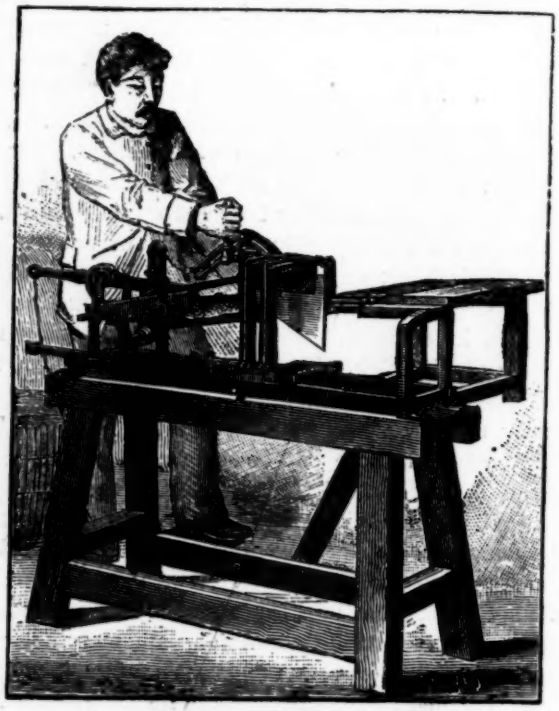


FIG. 1.—MACHINE FOR CUTTING CORK-STRIPS.

woman or a child to work it (Fig. 2). This machine separates the squares automatically, according to their sizes, and by an ingenious arrangement the knives are made to sharpen themselves by passing over a whetstone-rubber at each forward and return motion. With the third machine, for shaping the corks, five thousand corks may be finished in a day (Fig. 3). It is so arranged that the square of cork, firmly fastened between two pointed jaws, turns with them in front of a knife-blade, which is managed with the hand after the fashion of a plane. This blade is so connected by a chain-gearing with the jaws holding the cork, that the movements of the two tools are in harmony with one another. The parts of this machine can be arranged to cut corks of any size, and of cylindrical or conical shape as

may be desired. The conical corks are used when the corking is done by hand, the cylindrical ones when it is done by machinery. Other machines for punching corks into shape and for grinding them have been tried and discarded. M. Moreau, the inventor of the latter machine, combined with it the idea of cutting a portrait-face on the cork,

FIG. 2.—CORK-SQUARE CUTTING-MACHINE.

so that every house might send out the image of its chief on its wares; but the device has not advanced further than to the stage of a happy thought. Another machine has been invented in which the knife is a rotating disk, self-sharpening, and the cork also turns.

After having been shaped, the corks are washed in water containing oxalic acid or chloride of tin, or are sometimes treated with sulphuric acid. They thus acquire a characteristic salmon tint, and become velvety and soft to the touch. They are then sorted according to size, tested for quality, counted by hand or by the aid of special machines, and packed in sacks containing from fifteen to thirty thousand each.

The quality most sought in a good cork is impermeability to gases and liquids. The bark may be tested for this quality before making up, by means of an apparatus invented by M. Salleron, in which it is subjected to the pressure of a liquid which has already been compressed in a hydraulic machine. A cork of the first quality should stand a pressure of several atmospheres without absorbing any of the

liquid. The waste in cork-making amounts to about sixty per cent; but the chips can all be put to profitable use in making chalk-powders, linoleum, and feltings.

A large number of other substitutes for stoppers of cork have been tried. Those which have given the most satisfaction, in particular cases, are made of ground-glass and India-rubber; but no other device has come into a real competition with cork.

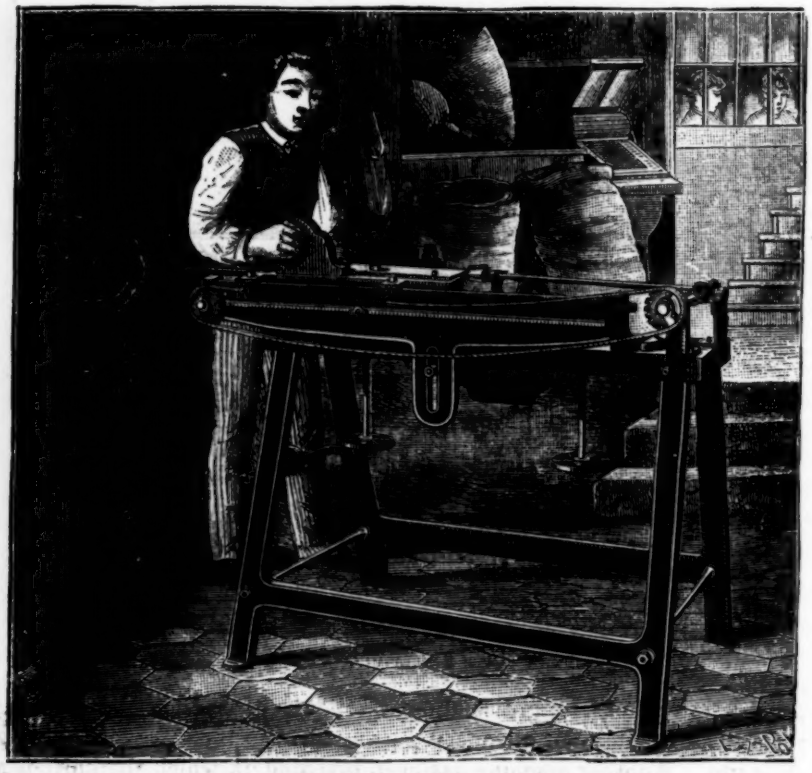


FIG. 8.—MACHINE FOR TRIMMING CORKS.

Mr. William Anderson, describing some new applications of the mechanical properties of cork to the arts, insists, as the peculiar quality which distinguishes it from all other solid or liquid bodies, upon its power of altering its volume in a very marked degree in consequence of change of pressure. All liquids and solids are capable of cubical compression or extension, but to a very small extent; thus water is reduced in volume by only $\frac{1}{20000}$ part by the pressure of an atmosphere. Liquid carbonic acid yields to pressure much more than any other fluid, but still the rate is very small. Solid substances, with the exception of cork, offer equally obstinate resistance to change of bulk, even India-rubber, which most people would suppose capable of very considerable change of volume, being really very

rigid. The latter substance can be compressed indefinitely in one direction while it is left free to move and expand in other directions. When tightly inclosed so that it can not yield, it can not be compressed by any force that can be brought to bear upon it. In the former case all the volume which is lost by the pressure in one direction is regained by the expansion in other directions, and the whole is not changed; in the latter case there is no room for the compensatory expansion; so when India-rubber is stretched, it gains in volume in one direction at the expense of an equivalent loss in other directions.

Metals, when subjected to pressures which exceed their elastic limits, so that they are permanently deformed, as in forging or wire-drawing, remain practically unchanged in volume per unit of weight. Cork behaves in a very different manner. If a cylinder of cork is tightly inclosed in a tube in the same manner as the India-rubber which refused to yield to any force, and pressure is applied to it, it is readily and visibly compressed; and when released it expands back to its original volume. In this case a great change in the volume of the material is easily effected.

When cork is subjected to alternate applications and relaxations of pressure, it coincidently contracts and expands. It is this singular property which gives it its value as a means of closing the mouths of bottles. Its elasticity has not only a very considerable range, but it is very persistent. The extent to which the better class of corks used in bottling the effervescent wines will expand the instant they escape from the bottles, is well known. As measured by Mr. Anderson, this expansion amounts to an increase of seventy-five per cent in the volume, even after the corks have been kept under compression for ten years. If the cork be steeped in hot water, the volume will continue to increase till it becomes nearly three times that which the cork occupied in the neck of the bottle.

When cork is subjected to pressure, either in one direction or from every direction, a certain amount of permanent deformation or "permanent set" takes place very quickly. This property is common to all solid elastic substances when strained beyond their limits of elasticity, but with cork the limits are comparatively low; thus, in chemists' and other shops, when a cork is too large to fit a bottle, the shopkeeper gives it a few sharp bites, or squeezes it with pincers to beyond its elastic limits, and so makes it permanently smaller. Besides the permanent set, there is a certain amount of what might be called sluggish elasticity; that is, cork on being released from pressure, springs back a certain amount at once, but the complete recovery takes an appreciable time.

These peculiar and valuable properties of cork are easily explained after examining its structure. The corky part of bark is composed of closed cells exclusively, and this part is developed to a very unusual degree in the cork-oak. A section of cork, taken in the horizontal

plane, such as is represented magnified in Fig. 4, microscopically examined, will show that the whole substance is made up of minute, many-sided cells about $\frac{1}{100}$ of an inch in diameter, and about twice as long, the long way of the cells being disposed radially to the trunk. The walls of the cells are extremely thin, and yet they are wonderfully impervious to liquids. Looked at by reflected light, if

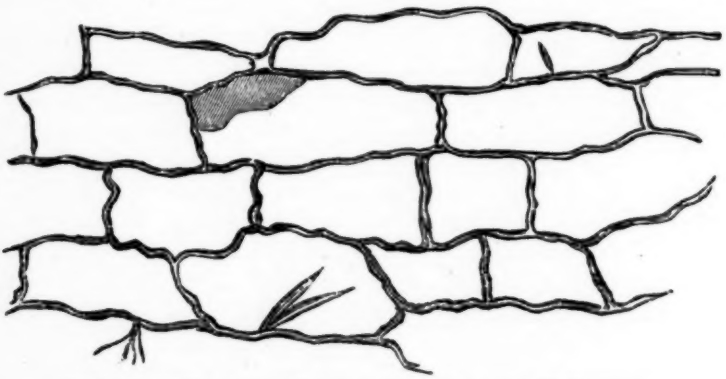


FIG. 4.—CORK, HORIZONTAL SECTION, MAGNIFIED ABOUT 300 DIAMETERS.

the specimen be turned, bands of silvery light alternate with bands of comparative darkness, showing that the cells are built on end to end in regular order. The vertical section (Fig. 5) shows a cross-section of the cells looking like a minute honey-comb. In some specimens large numbers of crystals are found, and are readily distinguished by the aid of polarized light. Minute though they are, they are very numer-

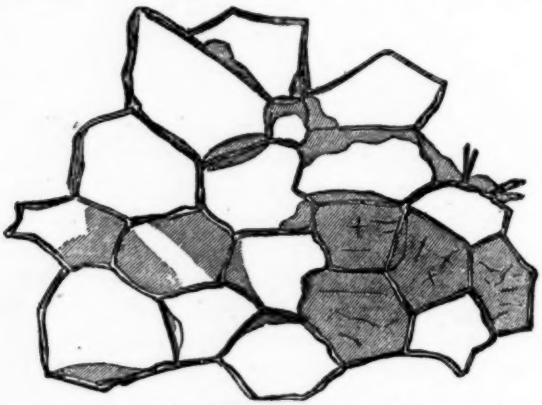


FIG. 5.—VERTICAL SECTION.

ous and hard, and it is partly to them that is due the extraordinary rapidity with which cork blunts the cutting-instruments used in shaping it. Cork-cutters always have beside them a sharpening-stone, on which they are obliged to restore the edges of their knives after a very few cuts; and the machines we have described are for the same

reason provided with devices for the automatic sharpening of the knives. The cells of the cork are filled with gaseous matter, which Mr. G. H. Ogston has proved by analysis to be common air, and to exist occluded in the cork, to the amount of about fifty-three per cent of its volume. The facility with which this air escapes when placed in an exhausted receiver, is very remarkable when compared with the impermeability of cork to liquids. It is the coexistence of these two properties—that of allowing gases to permeate while completely barring liquids, both of which are easily and clearly demonstrated by suitable experiments—that enables cork to be kept in compression under water or in contact with various liquids without the air-cells becoming water-logged ; and it is the same properties that make cork so admirable an article for water-proof wear, such as boot-soles and hats. By virtue of the combination, it is superior to India-rubber, for it allows ventilation to go on while it keeps out the wet. The cell-walls are so strong, notwithstanding their extreme thinness, that they appear when empty to be able to resist the atmospheric pressure, for the volume of the cork does not sensibly diminish, even when all the air has been extracted. Viewed under very high power, cross-stays or struts of fibrous matter may be distinguished traversing the cells, which, no doubt, add to the strength and resistance of the structure.

We conclude, then, that cork consists practically of an aggregation of minute air-vessels, having very thin, very water-tight, and very strong walls, and hence, if compressed, we may expect the resistance to compression to rise more like the resistance of gases than the resistance of an elastic solid such as a spring. In a spring the pressure increases in proportion to the distance to which the spring is compressed, but with gases, the pressure increases in a much more rapid manner—that is, inversely as the volume which the gas is made to occupy. But, from the permeability of cork to air, it is evident that if subjected to pressure in one direction only, it will gradually part with its occluded air by effusion—that is by its passage through the porous walls of the cells in which it is contained.

On the other hand, if cork be subjected to pressure from all sides, such as operates when it is immersed in water under pressure, then the cells are supported in all directions, the air in them is reduced in volume, and there is no tendency to escape in one direction more than another. An India-rubber bag distended by air bursts if pressed between two surfaces, but if an India-rubber cell be placed in a glass tube and subjected to hydraulic pressure, it is merely shriveled up, the strain on its walls is actually reduced.

To take advantage of the peculiar properties of cork in mechanical applications, it is necessary to determine accurately the law of its resistance to compression. For this purpose, Mr. Anderson introduced a quantity of cork into a strong iron vessel of five and a half gallons capacity, and filled the interstices full of water, carefully getting out

all the air. He then proceeded to pump in water, until definite pressures up to one thousand pounds per square inch had been reached, and, at every one hundred pounds, the weight of water pumped in was determined. In this way, after many repetitions, he obtained the decrease of volume, due to any given increase of pressure. The observations have been plotted into the form of a curve (Fig. 6). The

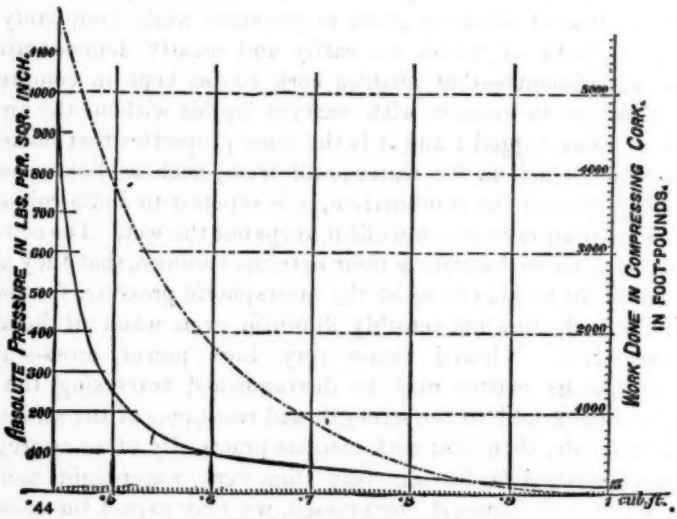


FIG. 6.—VOLUME OF CORK.

base-line represents a cylinder containing one cubic foot of cork, divided by the vertical lines into ten parts; the black horizontal lines according to the scale on the left hand represent the pressures in pounds per square inch which were necessary to compress the cork to the corresponding volume. Thus, to reduce the volume to one half, required a pressure of two hundred and fifty pounds per square inch. At one thousand pounds per square inch the volume was reduced to forty-four per cent; the yielding then became very little, showing that the solid parts of the cells had nearly come together, and this corroborates Mr. Ogston's determination, that the gaseous part of cork constitutes fifty-three per cent of its bulk. The engineer, in dealing with a compressible substance, requires to know not only the pressure which a given change of volume produces, but also the work which has to be expended in producing the change of volume. The work is calculated by multiplying the decrease of volume by the mean pressure per unit of area which produced it. The ordinates of the dotted curve on the diagram with the corresponding scale of foot-pounds on the right-hand side are drawn equal to the work done in compressing a cubic foot of cork to the several volumes marked on the base-line. The author has not been able to find an equation to the pressure-curve; it seems to be quite irregular, and hence the only way of calculating the

effects of any given change of volume is to measure the ordinates of the curve constructed by actual experiment. As may be supposed, the pressures indicated by experiment are not nearly so regular and steady as corresponding experiments in a gas would be, and the actual form of the curves will depend on the quality of the cork experimented on.

So far as preservation of elasticity during years of compression is concerned, we have the evidence of wine-corks to show that a considerable range of elasticity is retained for a very long time. With respect to cork subjected to repeated compression and extension, there is very little evidence to be offered beyond this, that cork which had been compressed and released in water many thousand times, had not changed its molecular structure in the least, and had continued perfectly serviceable. Cork which has been kept under a pressure of three atmospheres for many weeks, appears to have shrunk to from eighty to eighty-five per cent of its original volume.

Mr. Anderson has brought under notice two novel applications of cork to the arts:

One is in the water-raising apparatus called a hydraulic ram, the structure of which is shown by Fig. 7. The ram consists of an inclined pipe, A, which leads the water from a reservoir into a chamber, B, which terminates in a valve, C, opening inward. Branching up

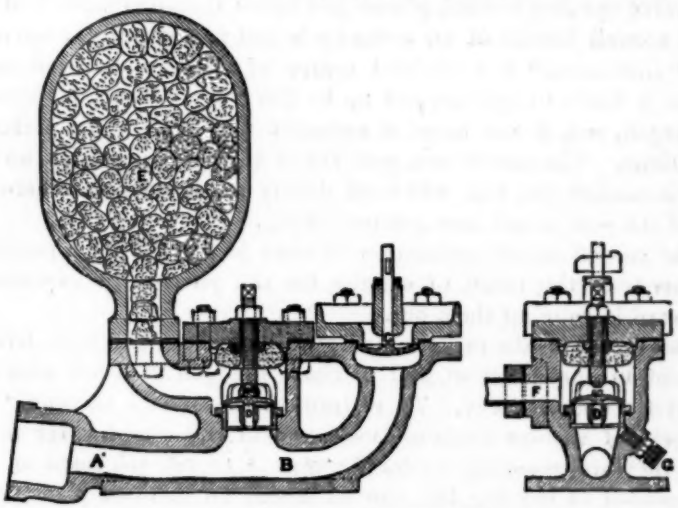


FIG. 7.—CORK IN A HYDRAULIC RAM.

from the chamber is a passage leading to a valve, D, opening outward and communicating with a regulating-vessel, E, which is usually filled with air, but which the author prefers to fill with cork and water. Immediately beyond the inner valve is inserted a delivery-pipe, F, which is laid to the spot to which the water has to be pumped, in this case to the fountain-jet in the middle of this pan.

The action of the ram is as follows: The outer valve C, which

opens inward, is, in the first instance, held open, and a flow of water is allowed to take place through it down the pipe and chamber. The valve is then released, and is instantly shut by the current of water which is thus suddenly stopped, and, in consequence, delivers a blow similar to that produced by the fall of a hammer on an anvil, and, just as the hammer jumps back from the anvil, so does the water recoil back to a small extent along the pipe.

During this action, first, a certain portion of water is forced by virtue of the blow through the inner valve D opening outward into the cork vessel, and so to the delivery-pipe, and instantly afterward the recoil causes a partial vacuum to form in the body of the ram and permits the atmospheric pressure to open the outer valve C and re-establish a rush of water as soon as the recoil has expended itself. In the little ram here represented, this action, which it has taken so long to describe, is repeated one hundred and forty times in a minute. The practical action of the ram, as modified by Mr. Anderson, demonstrates that the elasticity of cork is competent to regulate the flow of water. When air is used for this purpose, the air-vessel has to be filled, and, with most kinds of water, the supply has to be kept up while the ram is working, because water under pressure absorbs air. For this purpose a "sniff-valve," G, is a necessary part of all rams. It is a minute valve opening inward, placed just below the inner valve ; at each recoil a small bubble of air is drawn in and passed into the air-vessel. This "sniff-valve," is a fruitful source of trouble. Its minuteness renders it liable to get stopped up by dirt ; it must not, of course, be submerged, and, if too large, it seriously affects the duty performed by the ram. The use of cork gets rid of all these difficulties, no sniff-valve is needed, the ram will work deeply submerged, and there is no fear of the cork vessel ever getting empty.

The second novel application of cork is for storing a portion of the energy of the recoil of cannon, for the purpose of expending it afterward in running them out.

The result of the explosion of gunpowder in a gun is to drive the shot out in one direction, and to cause the gun to recoil with equal energy the opposite way. To restrain the motion of the gun, "compressors" of various kinds are used, and in this country, for modern guns, they are generally hydraulic, that is to say the force of recoil is expended in causing the gun to mount an inclined plane, and, at the same time, in driving a piston into a cylinder full of water, the latter being allowed to squeeze past the piston through apertures, the areas of which are either fixed, or capable of being automatically varied as the gun recedes ; or else the water is driven out of the cylinder through loaded valves. As a rule, the gun is moved out again into its firing position by its weight causing it to run down the inclined plane, up which it had previously recoiled. For naval purposes, however, this plan is inconvenient, because the gun will not run

out to windward if the vessel is heeling over, on account of the inclined plane becoming more horizontal, or even inclined in the reverse direction; and should the ship take a permanent list, from a compartment getting full of water, the inconvenience might be very considerable.

In land-service guns, when mounted in barbette, the rising of the gun exposes it and the loading detachment more to the enemy's fire; and in both cases, when placed in ports or embrasures, the ports must be higher than if the gun recoiled horizontally, and will therefore offer a better mark to the enemy's fire, especially that of machine-guns, while the sudden rise of the gun in recoiling imposes a severe downward pressure on the deck or on the platform.

To obviate these disadvantages, the author has contrived the gun-carriage, of which Fig. 8 illustrates the internal construction. The

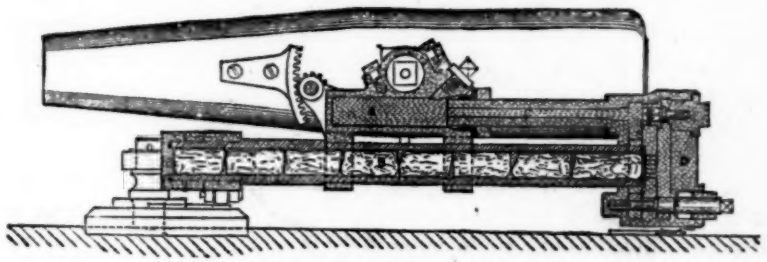


FIG. 8.—CORK BUFFER FOR A GUN.

gun is mounted on a carriage composed of two hydraulic cylinders, A, united so as to form one piece. This carriage slides on a pair of hollow ways, B, and also on to a pair of fixed rams, C, the rear ends of which are attached to the piece D forming the rear of the mounting. There are water-passages down the axes of the rams, and these communicate through an automatic recoil-valve, E, opening from the cylinders, with the two hollow sides B. There is a second communication between the cylinders and slides by means of a cock, F, which can be opened or shut at pleasure. The hollow slides are packed full of cork and water, the latter also completely filling the cylinders, rams, and various connecting passages. By means of a small force-pump, enough water can be injected to give the cork so much initial compression as will suffice to run the gun out when the slides are inclined under any angle which may be found convenient. When the gun is fired, the cylinders A are driven on to the rams C, and the water in the cylinders is forced through the hollow rams into the cork and water vessels formed by the slides B, and the cork is compressed still further. When the recoil is over, the automatic recoil-valve E closes, and the gun remains in its rearward position ready for loading. As soon as loaded, the running-out cock F is opened, the expansion of the cork drives the water from around it into the cylinders, and so forces the

gun out. If it be desired to let the gun run out automatically immediately after recoil, it is only necessary to leave the running-out cock F open, and then the water forced among the cork by recoil returns instantly to the cylinders, and runs the gun out quicker than the eye can follow the motion.

The arrangement adopted may be made by using air instead of cork, but air is a troublesome substance to deal with; it leaks out very easily and without showing any signs of having done so, which might readily lead to serious consequences. A special pump is required to make up loss by leakage.

The merit of cork is its extreme simplicity and trustworthiness. By mixing a certain proportion of glycerine with the water it will not freeze in any ordinary cold weather.

Each of the applications of cork is based on some of the physical or chemical properties of the substance. In bottle-corks its impermeability, elasticity, and imputrescibility are brought into service. Its lightness, the first quality that strikes us, on a superficial view, is not considered.

Cork is used for a variety of other purposes than those which have been mentioned, which, while not so economically important as these, still deserve attention. The male cork, while not well adapted for stoppers, has been made available in the decoration of parks and gardens. Rice-hulling mills have been made from it, but not with much success; small corks can be got out of it. Water-conduits and bee-hives have been constructed from it. It furnishes excellent damp-proof shelves and stands. The Kabyles employ it, mixed with a mortar of mud, in building the walls of their houses, and shingle their roofs with it. It is used for the floats of fish-nets.

These various applications were known, as we learn from expressions of Theophrastus and Pliny, to the Greeks and Romans. Pliny says: "Only that bark is used that is thick and springs back when it is pulled. It is sometimes employed for the buoys of ships' anchors, fishermen's nets, barrel-bungs, and women's winter sandals. The Greeks felicitously called the cork-oak the bark-tree. Cork is used for the covering of roofs." The chips form a good non-conducting material for keeping ice, and reduced to fragments make excellent stable-floors and race-course tracks.

The real, or female cork, has a more homogeneous grain and works much better than male cork. It is a very poor conductor of heat and sound, and has been found valuable to protect hot surfaces against cooling, and to keep frigid substances from melting. It is the basis of several non-conducting mastics and coverings, which are used for protecting pipes, steam-boilers, hot-water reservoirs, etc. Three methods of applying the cork-covering are employed in France. Strips of cork touching at their edges may be laid along the pipes and cylinders and drawn together by wire as in No. 1, Fig. 9. The pipe clothed in

this way is a tangent to the inner surface of all the strips, and presents in section a circumference inscribed within a polygon. In the second method, No. 2, thin strips of cork, glued to cloth, by a kind of India-rubber cement, are wrapped spirally round the pipe. The third method consists in employing two hollowed half-cylinders (No. 3) exactly fitting the surface of the pipe. These cylinders, which can be

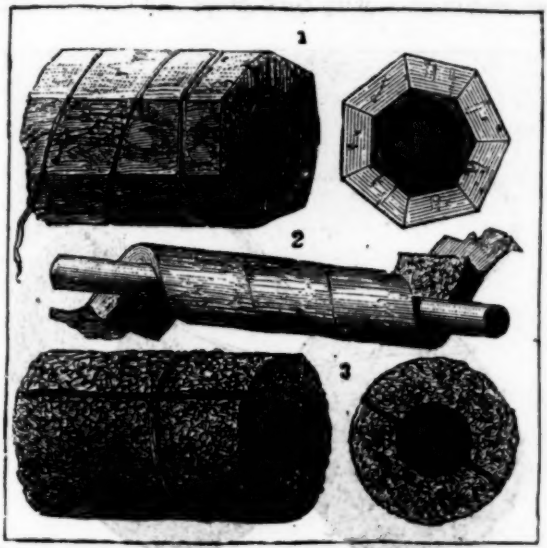


FIG. 9.—PIPES COVERED WITH NON-CONDUCTING CORK. No. 1, bands laid side by side. No. 2, band of cork pasted on cloth and rolled in spiral shape. No. 3, artificial cork.

made of any length, are composed of cork-powder mixed with starch, and are covered with strips of cotton cloth rolled spirally over them, which can be painted with coal-tar or any other suitable paint. Either of the methods will effect a great economy of fuel.

Cork, being also a very poor conductor of sound, is employed successfully in finishing the interior of telephone-cells. It may be put over the doors of consulting-offices; floors made of it are very acceptable in cure-houses and sick-chambers; and it has been adopted in some stringed musical instruments to prevent waste of sound.

Cork has superior buoyant qualities, which are sufficient not only to keep it on the surface, but also to enable it to support tolerably heavy bodies. It is thus employed as a float for night-lamps, for bath-thermometers, and for fish-lines. It is excellently adapted to use in swimming-jackets and life-saving apparatus, in the construction of which inventors have exercised their genius industriously. Many ships carry cork mattresses, which have proved of great service in cases of shipwreck. Life-saving buoys are composed of pieces of cork, are usually in the form of rings, and are furnished with knotted pieces of rope, permitting them to be easily taken hold of. They are also usually covered with painted sail-cloth, to insure their preservation.

By the aid of the weighted floating stakes represented in Fig. 10, it is practicable to rescue a person who has fallen into the water at a short distance from the quay on the shore. The slide allows the cord to be taken between two fingers, and the apparatus to be thrown like a sling. This instrument is composed of a rattan or stick of Malacca-wood, having projecting points, around which lead is melted; the whole is then surrounded with cork chips and covered with cloth and

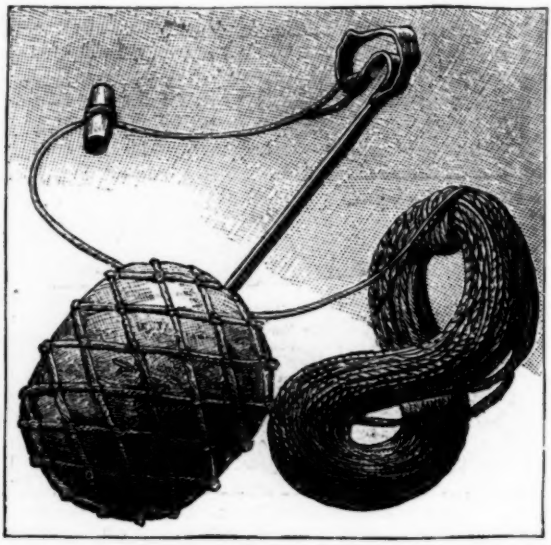


FIG. 10.—FLOATING LEADED-STAKE BUOYED WITH CORK (life-preserver). The apparatus is represented with the line, which is uncoiled when it is thrown into the water.

outside with a network to protect it against friction. Other forms of life-saving apparatus are exemplified in the cork jacket and life-buoy represented in Fig. 11. Rubbers are made of cork inclosed in canvas sacks, and placed along the sides of ships to lessen the shock of their friction against the pier.

The Roman women's custom of wearing cork soles, mentioned by Pliny, has not yet died out, for cork soles are common in the wardrobes of the present day. Cork heels were invented in the time of Louis XV, to be worn inside of the shoe, so as to increase the apparent height of the wearer, without displaying an outer heel. Cork is also useful at the other extremity of the body, shaped into helmets, or as a kind of lining for high hats, or in ventilating-bands, for the protection of the head in hot countries against insolation. Women in the barbarous days, when dead birds were worn in hats, used cork bodies, to which eyes beaks, and features were added, as the molds for their ornithological structures. Trimming-makers use cork molds or bodies, which they cover with silk or cotton to form elaborate ornaments for mantles and cloaks. Cravats and babies' bibs have been

made of cork ; and in water-proof garments this material is preferable to India-rubber, in that it allows a freer passage to the air.

Among other miscellaneous applications, may be named those for prosthesis in surgery, naturalists' blocks, rolling-pins for pastry, bath-landings, and wine-labels. The facility with which it is cut, makes cork available for fanciful works of art, as in landscape combinations,

FIG. 11.—CORK JACKET AND LIFE-BUOY.

models of monuments, cases for inclosing bottles to be mailed, spools for silk, the inkstands of our fathers' childhood ; pen-holders, which being large and light, do not cramp the fingers, and hundreds of other articles of the kind. There is hardly a profession that does not make more or less use of cork. Gold-burnishers make their rubbers from it, and crystal-polishers their wheel-surfaces. It forms a very light and convenient mounting for watch-makers' lenses, which is used with a minimum amount of fatigue to the muscles of the eye. Applied as a tire to pulley-wheels, it secures a firmer adhesion of the bands. The stoppers of sucking-bottles have been replaced by cork tips which, being very cheap, can be renewed when the presence of a ferment in them is suspected. Cork is also used in a great many children's toys and plays ; in fixing wigs on the heads of dolls ; in toy guns and pistols ; in shuttlecocks and skittles to be played in rooms. In fact, one is almost tempted to inquire to what use it can not be put.

The manufacture of all these various articles naturally involves the production of considerable quantities of cork-clippings; these, together with the waste incurred in gathering the crop, and with old cast-away corks, constitute the raw material with which a number of important industries are fed. The coarser chips are sought for as packing material for fragile articles, in which their elasticity gives them a peculiar value. The finer particles constitute suberine powders, the balsamic properties of which are well known to hygienists. In treating the rashes of new-born children, they take the place of lycopodium and starch-powders. An insecticide, which is offered under the name of Zifa powder, is composed of cork mixed with phenol. Fire-kindlings have been made of cork-powder, but they do not seem to have given any grand results. The most important application which has been made of cork-refuse is in the manufacture of linoleum. For this fabric, cork-powder is mixed with oxidated linseed-oil. The resultant paste is then spread upon cloth if a carpeting is to be made, or on paper, if hangings are in view. The color, which is a little darker than that of cork, may be enlivened by colored designs. Applied to moist walls as a foundation, or in hangings, linoleum will receive more substantial paintings than wood which warps, or plaster, or other materials, which are liable to crack. Ceilings may be made from it, which can be washed whenever they become soiled or smoked. When used for carpets, linoleum makes the floors quite insonorous, and transforms damp and unhealthy rooms into warm and salubrious habitations. It has the advantage, for kitchens and offices, of not being stained by grease. A new decorative product, lino-burgau, is obtained by fluting linoleum, and by the application of colored varnishes and the metalization of some parts giving beautiful iridescent effects.

A composition of coarse powder of cork and milk of lime, pressed into bricks or tiles, forms an excellent material for the construction of conduits, the lining of damp walls, and for roofs. Lining of the cellars of breweries with these tiles diminishes the melting of the ice; in gunpowder-factories it prevents the deterioration of the powder by damp, and, by virtue of its levity and friability, helps to decrease the damage in case of explosion. Employed as pugging for floors, they destroy the disagreeable resonance. In the spinneries of Alsace and Eastern France, the bricks have proved effective to resist the passage of sound, of heat and cold, and are economical withal.

When distilled in a close vessel, chips and waste of cork give off an illuminating gas, which is capable of shedding a brighter light than coal-gas, and is free from the sulphurous emanations which are so objectionable in that illuminant. When tried for lighting the city of Nérac, the difficulty of providing storage for the immense bulk of chips, needed to furnish the required amount of gas, proved so for-

midable an obstacle to its general use, that the system had to be given up.

Lastly, the extremely fine and durable paint, cork-black, or Spanish-black, is made from carbonized chips and waste of cork.

A BOTANICAL BONANZA.

By F. E. BOYNTON.

TAKE a map of the Southern States, and find a point directly northwest of the spot where North Carolina, South Carolina, and Georgia corner. Taking this for a center, describe a circle, whose radius shall extend twenty miles.

Within this bound will be represented a section which probably contains more interesting and rare plants than can be found in any part of the United States occupying the same area.

This district was undoubtedly visited by the elder Michaux. Professor Sargent furnishes me with a short extract from the old botanist's journal, the original of which is in the possession of the Philadelphia Academy of Sciences, in which he describes a trip he made up the Keowee River, and finally up the mountain-streams which form the head-waters of the Keowee. This route naturally led him to pass through the region that I have described. Here it was that *Robinia viscosa* and *Shortia galacifolia* were first found—two plants which were for so long a time thought to be lost species.

Although much of the Alleghany Mountain region has been thoroughly explored by later botanists, this particular spot seems to have been unnoticed until lately—probably on account of its being so difficult to reach from any railroad-station, for the district embraces a very wild and broken mountain-region.

Not far from where I proposed to make the center of our circle, *Rhododendron Vaseyi* grows in profusion. This showy plant is found along an old, long-traveled trail, but was unnoticed until a short time ago. *Tsuga Caroliniana*, the new and rare hemlock, is common on a mountain (Whitesides) which has been visited annually by tourists for half a century, but it remained unnoticed until within a short time. *Robinia viscosa* is a common plant on nearly all the mountain-tops around, but was searched for in vain for nearly a century until it was rediscovered a few years ago. One circumstance, which perhaps helped to obscure it, is that in its natural state it is only a low shrub, not much larger than its near relative, *R. hispida*, with which it is associated, while in cultivation it makes a considerable tree. Professor Sargent, while exploring the head-waters of the Keowee, last September (1886), in search of *Magnolia cordata*, obtained a plant which proved to be the rare *Shortia galacifolia*. Since then it has been

found in considerable numbers near where the professor made the discovery.

I will name a few of the interesting if not rare plants that I have collected here during the present season: *Ilex monticola*, *Ilex mollis*, *Gaylussacia ursina*, *Dyrhylleia cymosa*, *Parnassia asanfolia*, and *Drosera rotundifolia*. The little *Houstonia serpyllifolia* grows on the banks of all the mountain-streams, while *H. elongifolia* grows on the drier hill-sides. *Galax aphylla* is interesting to me, on acccount of the beautiful tints which its leaves put on during the winter months, which make it one of the most enlivening features of the landscape during that season. I might fill pages describing plants that occur here, that would be most interesting objects of study to those who have never visited this region; but my principal object in writing this is to suggest the query whether it is not probable that there are undiscovered plants yet to be found in a part of the country which is so virgin and has been so little explored as this.

SPEECHES AT THE RECENT TYNDALL BANQUET.

By Professors STOKES and TYNDALL, Sir LYON PLAYFAIR, the Earl of DERBY, and Others.

AT the dinner given to Professor Tyndall in London, on the 29th of June, the chairman, Professor Stokes, in proposing the health of the guest of the evening, said: A social gathering like the present is not an occasion on which it is desirable to enter into detail as to the scientific labors of a man, however eminent. Yet the circumstances of the present meeting seem to demand that I should say a few words on some of Dr. Tyndall's researches. Some of his earliest scientific work related to diamagnetism and magnecrystallic action, and in part of this he was associated with the well-known German physicist, Knoblauch. But I can not dwell on these now. And I will even dismiss with this brief mention his researches on the properties of ice and his application of them to the theory of glaciers and the observations which he made in common with his friend and colleague Professor Huxley, whose necessary absence from among us to-night we so much regret. If I be not trespassing too much on the patience of those who listen to me, I would wish to say a little more on that elaborate series of researches, forming no less than six separate papers in the "Philosophical Transactions" in which Dr. Tyndall investigated the relation of simple and compound gases and of vapors to radiant heat, especially radiant heat from sources at a moderate temperature. According to his researches, while the main constituents of the earth's atmosphere, nitrogen and oxygen, are practically diathermous, at least with regard to radiations which can traverse rock-salt, as we know that by far the greater part

of those that we have to deal with can, such is far from being the case with other gases equally transparent with regard to light. Dr. Tyndall found that as a rule the more complex the composition of a gas the greater is its defect of diathermancy. To confine ourselves to the two gases which occur in the atmosphere mixed with its main constituents —I allude of course to carbonic acid and to water in the gaseous state of vapor—he found that both, especially the latter, which likewise is present in by far the larger quantity, are very distinctly defective in diathermancy, and he concluded that the main part of the absorption of solar heat in passing through the atmosphere, absorption as distinguished from scattering, is due to the watery vapor which it contains. From this result he drew important inferences as to atmospheric temperature and climatological conditions. Dr. Tyndall's researches on the relation of gases to radiant heat came naturally before me during my long tenure of office as one of the Secretaries of the Royal Society; and for my own part I may say that it seemed to me all along that the results were established on so firm a basis, and the conclusions regarding the invisible radiations were so perfectly analogous to what we know to be true regarding the visible ones, where the investigation is comparatively easy, that the work bore on it the stamp of truth. The conclusions were not, however, accepted without opposition. In the late Professor Magnus, Dr. Tyndall met a foeman worthy of his steel; a foeman, however, only in the sense of an intellectual athlete; for socially I doubt not they were the firmest friends, and their friendship was even cemented by the fact that they were both alike seeking after truth in a similar subject. But truth only gains by opposition: its defenders are led to engage in fresh researches, which end in strengthening its foundations. I think that the validity of Dr. Tyndall's results is now generally admitted. If some hesitation is still felt, it arises mainly, I think, from misconception; from imagining that assertions which were meant to apply only to heat-rays of such refrangibilities as to be absorbed by water were meant to be affirmed of the invisible radiations generally which lie beyond the extreme red. The time reminds me that I must only very briefly refer to another investigation in which Dr. Tyndall has more recently been engaged, and of which the interest is biological, while the means of investigation are physical; I allude, of course, to the question of abiogenesis. Here, again, Dr. Tyndall was working on contested ground, and the objections of opponents stimulated him to fresh inquiries, which resulted in the continual strengthening of his negative conclusions. In the course of his work he was led, for instance, to the discovery of the great difference which exists between the germs of microscopic creatures and the creatures themselves, in relation to their power of resisting the destructive influence of a high temperature. This discovery not only detected a source of error in some experiments which had seemed to favor the hypothesis of abio-

genesis, but threw important light on the conditions which must be fulfilled in order to secure complete sterility. But original research is not the only way in which a man can advance the cause of science. All-important though it is, it nevertheless often happens that an original investigation is too abstruse to be followed by more than a few experts; nor is it by any means necessarily the case that an eminent investigator is equally successful in expounding to others, especially to a mixed audience, the results at which he himself or other investigators may have arrived. The general diffusion of science depends largely on the clearness with which its leading principles and results are expounded, whether by lectures or by treatises, in which, while they are scientifically sound, popularity of style and general readableness are not sacrificed to the dry exactness of scientific detail. Most of us have had opportunities, whether at the Royal Institution, with which the name of Tyndall has so long been connected, or elsewhere, of being impressed with the singularly lucid style and graphic expression with which he expounded to his audience the salient points of the scientific subject which he brought before them. Nor was it only in clearness of verbal exposition that he excelled; the manipulative skill with which his original investigations were carried on served him in good stead in his more popular expositions; and by the aid of that "domestic sun," which even the murky atmosphere of a London winter could not obscure, he was enabled in very many cases to exhibit to the audience the actual results of experiments which had first been carried out in the quiet of the laboratory. Nor is it our own countrymen alone who have had the benefit of Dr. Tyndall's lucidity of exposition. Our friends across the ocean have flocked to hear and have appreciated the lectures which he has there delivered as a free gift to transatlantic science. But oral lectures, after all—the lectures at least of one individual—can only reach a fraction of the community; nor do they admit of that pause for thought which the learner requires in endeavoring to make himself master of a new subject. But the same qualities of mind which enable a man to be a clear and interesting lecturer fit him also to be the author of eminently readable books; and for the general diffusion of science which is taking place we owe much to the writings of Dr. Tyndall.

PROFESSOR TYNDALL'S SPEECH.

MR. PRESIDENT, MY LORDS, AND GENTLEMEN: When the project of a dinner was first mentioned to me by a very old and steadfast friend of mine, who, to my regret and his, is not here to-night, had any dream, or vision, of the assembly now before me risen on my mind's eye, I should have declined the risk of standing in my present position; for I should have doubted, as I still continue to doubt, my ability to rise to the level of the occasion. Gratitude, however, is possible to all men; and I would offer you, sir, my grateful thanks for

the manner in which you have proposed this toast; I would thank with equal warmth an assembly which, in intellectual measure, is, probably, as distinguished as any of the same size ever addressed by man, for the way in which they have received it; and I would extend my thanks to my friends of the Department of Science and Art, for their spontaneous kindness to an old colleague, who for many years lent his humble aid to the department in diffusing sound scientific knowledge among the masses of the people. My own scientific education began late. It had, of necessity, to be postponed until after I had reached the age of seven or eight and twenty. Notwithstanding this drawback, in learning, teaching, and working in the laboratory, I have been permitted to enjoy a spell of thirty-nine years. In 1850, during a flying visit from Germany to England, I stood, for the first time, in the bright presence of Faraday. In February, 1853, I gave my first Friday evening lecture in the Royal Institution; and three months afterward, on the motion of Faraday, the old chair of Natural Philosophy, which had been filled at the beginning of the century by Thomas Young, was restored, and to it I was elected. It causes me genuine pleasure to think that I shall be succeeded in that chair by so true and so eminent a man of science as Lord Rayleigh.

It is not my intention to overburden you with egotism to-night; but, casting an earnest glance back upon the past, a few words seem due from me to the memory of one or two of the group of good men, no longer with us, with whom I was so intimately associated. Regarding Faraday, I will confine myself to stating that years have not altered my estimate of the beauty and the nobleness of his character. He was the prince of experimental philosophers; but he was more than this—in every fiber of his mind he was a gentleman. It is, however, of two of our honorary secretaries that I wish now to speak; premising that, for the first seven years of my life in the Royal Institution, the post of honorary secretary was held by a cultivated and very worthy gentleman, the Rev. John Barlow. From 1860 to 1873—that is, for a stretch of thirteen memorable years—I had the happiness of working hand in hand with Dr. Bence Jones. Never in my experience have I met a man more entirely and unselfishly devoted to the furtherance of scientific work. I hardly like to mention the following incident, because it furnishes but a scanty measure of his devotion. On one occasion I was in need of funds to carry out some experiments of a delicate and costly character. Bence Jones came to me, and after some hesitation—for he knew that money was likely to raise a difficulty between us—he said, with earnestness: "Dear Tyndall, behave as my friend; do me the favor and the honor of devoting this to your investigation. There is more, if you need it, where that came from." He handed me a check for £100. Had I asked for £1,000, he would have given it to me, and the world, as far as he was concerned, would have been none the wiser. Bence Jones was a strong man, and

liked to have his own way. At first, as was natural, we sometimes surged against each other; but these little oppositions were rapidly adjusted, and for many years before his death the tie of brother to brother was not truer or tenderer than that which united myself and Bence Jones. On my return from the United States I found him dying. In fact, the knowledge of his condition caused me to take leave, earlier than I otherwise should have done, of a people that I had learned to trust and love. Soon after my return I saw him lowered into the grave.

The death of Bence Jones, whose steadfast loyalty to the Institution he loved so well, showed itself to the last, was a sore calamity to be met. At that time one man only seemed fitted to supply his place. That man was the beloved and lamented William Spottiswoode. To him I appealed to stand by the Institution at a critical hour of its fortunes. He had his own mathematical work on hand, and he was too well acquainted with the duties of our honorary secretaryship to accept them lightly. After much reflection, he wrote me a letter regretfully but distinctly declining the office. But he reflected a second time. He knew that his refusal would cause me pain, and his affection for me prevailed. When, therefore, the letter of refusal—for he sent it to me—came, it was accompanied by a second letter, canceling the refusal and accepting the post. With William Spottiswoode I had the happiness of working in close companionship for six years. The diligence, wisdom, and success with which he discharged his onerous duties—the princely hospitality which shed a glow upon the office while he held it—are well remembered. Of the dignity with which he afterward filled the high position now occupied by the illustrious man who presides here this evening it is needless to speak. Him also we have seen lowered to his rest, amid the grief of friends assembled to do honor to his memory. Such were the men who served the Royal Institution in the past; and their example has been worthily followed by other men of eminence, still happily among us. Never was an institution better served than the Royal Institution, and not by its honorary secretaries alone. With singleness of purpose and purity of aim, its successive presidents, boards of managers, and honorary treasurers have unswervingly promoted the noble work of investigation and discovery. May they never lower the flag which, for well-nigh a century, they have kept victoriously unfurled!

The year after my appointment I was called upon to deliver, in conjunction with Dr. Whewell, Faraday, Sir James Paget, and some other eminent men, one of a series of lectures on scientific education. I then referred with serious emphasis to the workers in our coal-mines, and to the terrible perils of their occupation. I pointed to the intellectual Samsons toiling with closed eyes in the mills and forges of Manchester and Birmingham, and I said, "Give these toilers sight by the teachings of science, and you diminish the causes of calamity,

multiply the chances of discovery, and widen the prospect of national advancement." Thus early, you will see, I was alive to the importance of technical education; and I am no less alive to it now. You will not, therefore, misunderstand me when I say that to keep technical education from withering, and to preserve the applications of science from decay, the roots of both of them must be well imbedded in the soil of original investigation. And here let it be emphatically added, that in such investigation practical results may enter as incidents, but must never usurp the place of aims. The true son of science will pursue his inquiries irrespective of practical considerations. He will ever regard the acquisition and expansion of natural knowledge—the unraveling of the complex web of Nature by the disciplined intellect of man—as his noblest end, and not as a means to any other end. And what has been the upshot of science thus pursued? Why, that the investigator has over and over again tapped springs of practical power which otherwise he would never have reached. Illustrations are here manifold. I might point to the industries which affiliate themselves with Faraday's discovery of benzol, and with his discovery of the laws of electrolysis. But I need not go further than the fact that in this our day a noble and powerful profession has been called into existence by his discovery of magneto-electricity. The electric lamps which mildly illuminate our rooms, the foci which flood with light of solar brilliancy our railway-stations and public halls, can all be traced back to an ancestral spark so small as to be barely visible. With impatient ardor Faraday refused to pause in his quest of principles to intensify his spark. That work he deliberately left to others, confidently predicting that it would be accomplished. And, prompted by motives both natural and laudable, but which had never the slightest influence on Faraday, others have developed his spark into the splendors which now shine in our midst.

It would be a handsome jubilee present, if it were a possible one, to roll up the career of Faraday into portable form, and to offer it to the Queen as the achievement of one of Her Majesty's most devoted subjects during her own reign. Faraday's series of great discoveries, however, began in 1831, which throws his work five or six years too far back. During the rest of his fruitful life he was a loyal son of the Victorian epoch. But, passing beyond the limitations of the individual, what is science, as a whole, able to offer, on the golden wedding of the Queen with her people? A present of the principle of gravitation—a handing over to Her Majesty of the bit and bridle whereby the compelling intellect of Newton brought the solar system under the yoke of physical laws—would surely be a handsome offering. I mention this case of known and conspicuous grandeur, in order to fix the value of another generalization which the science of her reign *can* proudly offer to the Queen. Quite fit to take rank with the principle of gravitation—more momentous if that be possible—is that

law of conservation which combines the energies of the material universe into an organic whole; that law which enables the eye of science to follow the flying shuttles of the universal power, as it weaves what the Earth Spirit in "Faust" calls "the living garment of God." This, then, is the largest flower of the garland which the science of the last fifty years is able to offer to the Queen.

The second generalization is like unto the first in point of importance, though very unlike as regards its reception by the world. For whereas the principle of conservation, with all its far-reaching, and, from some points of view, tremendous implications, slid quietly into acceptance, its successor evoked the thunder-peals which it is said always accompany the marriage of thought and fact. For a long time the scent of danger was in the air. But the evil odor has passed away; the air is fresher than before; it fills our lungs and purifies our blood, and science, in its jubilee offering to the Queen, is able to add to the law of Conservation the principle of evolution.

In connection with these victories of the scientific intellect, I have mentioned neither persons nor nationalities—holding, as Davy expressed it, when the Copley medal was awarded to Arago, that "science, like Nature, to which it belongs, is neither limited by time nor space. It belongs to the world, and is of no country and no age." Still, it will not be counted Chauvinism, if I say that in the establishment of these two great generalizations Her Majesty's subjects have quitted themselves like men. With regard to a third generalization, neither England nor Germany has been idle. Omitting the name of many a noble worker in both countries, the antiseptic system of surgery assuredly counts for something in the civilized world. And yet it is but a branch of a larger generalization, of momentous import, which in our day has been extended and consolidated to an amazing degree by a Gallic investigator. To some, however, any flower culled in this garden will be without odor. Let me therefore add a sweet-scented violet under the name of spectrum analysis which, besides revealing new elements in matter, enables the human worker to stretch forth his hand to sun and stars, to bring samples of them, as it were, into his laboratory, and to tell us, with certainty, whereof they are composed. Surely all these, and other discoveries of high importance, taken and bound together, form an intellectual wreath, not unworthy of Her Majesty's acceptance in her jubilee year.

A short time ago an illustrious party leader summed up the political progress of the Queen's reign. What I have said will, I trust, show that the intellectual world is not entirely compounded of party politics—that there is a band of workers scattered over the earth whose arena is the laboratory rather than the platform, and who noiselessly produce results as likely to endure, and as likely to influence for good the future of humanity, as the more clamorous performances of the politician.

One word more. On the Continent of Europe, kings had been the nursing fathers and queens the nursing mothers of science; while republican governments were not a whit behind in the liberality of their subventions to scientific education. In England we had nothing of this kind, and to establish an equivalent state of things we had to appeal, not to the Government, but to the people. They have been roused by making the most recondite discoveries of science the property of the community at large. And as a result of this stirring of the national pulse—this development of self-reliance—we see schools, colleges, and universities now rising in our midst, which promise by-and-by to rival those of Germany in number and importance.

It is time that I should cease; but, before doing so, I would ask—as they do in the House of Commons—permission to say a word in personal explanation. I have climbed some difficult mountains in my time, and after strenuous effort for a dozen hours or more upon ice, rock, and snow, I have not unfrequently reached the top. I question whether there is a joy on earth more exhilarating than that of the mountaineer, who, having achieved his object, is able to afford himself, upon the summit, a foaming bumper of champagne. But, my lords and gentlemen, the hardest climb, by far, that I have ever accomplished, was that from the banks of the Barrow to the banks of the Thames—from the modest Irish roof under which I was born to Willis's Rooms. Here I have reached my mountain-top, and you—God bless you!—have given me a bumper which no scientific climber ever before enjoyed.

AFTER-SPEECHES.

Sir Frederick Pollock, in proposing the toast of "Literature and Art," said that on most occasions similar to the present one this toast was a triple one, and included the three sisters—Science, Literature, and Art. But this evening they were assembled together to do homage to science, in the person of one of its most distinguished votaries, and for the time the room in which they had met became a temple of science. In such a temple the principal figure, standing upon the pedestal appropriated to the presiding goddess, must be that of Science, and to her due rites had been already rendered. But for the sisters, Literature and Art, room must be found also in the sacred edifice; they too must have their altars and their shrines. He pointed out that the highest powers of the imagination were required by the man of science, as well as by the poet and the painter, and instanced the prediction by Fresnel of the bright spot in the center of the shadow of a disk; and the suggestion made to Goethe of his theory of the development of the vertebrate skeleton, by his accidental observation of the scattered fragments of the deer's skull lying in his path. He adduced the names of Aristotle, Bacon, and other great men who had connected literature with science; and instanced Leonardo da Vinci and Sir Christopher Wren, one of the founders of the Royal Society,

as linking together science and art. He accordingly had great pleasure in submitting for acceptance "Literature and Art," coupling with it the name of Lord Lytton, who was not only a distinguished representative of modern literature, but had also a distinct hereditary claim to represent that of the last generation; and Sir Frederick Leighton, the distinguished President of the Royal Academy.

The Earl of Lytton.—In returning thanks for "Literature" upon an occasion when we are all met to honor science in the person of one of its most illustrious adepts, I can not but forcibly remember that we are living in an age when inquiry is more active and more wide-spread than conviction, and it is natural that in minds of the highest order under these conditions even the imaginative faculty should be more powerfully attracted to scientific research than to purely literary production. But inquiry, I think, would be very sterile if conviction in some form or another were not the ultimate fruit of it, and I think that for a period of really vigorous, creative, imaginative art, we must look forward, in the course of scientific research, to some such general resettlement of ideas upon the basis of a common conviction—which is not now, perhaps, altogether attainable—as may enable art, instead of representing, as it does now, merely the mental attitude of the individual poet or the individual painter, once more to become the universally spontaneous and universally recognized imaginative expression of ideas and emotions which are common to a whole generation or a whole community. If that is the case, if science is ultimately to render this great service to literature and art, surely, in the mean while, we can not but gratefully appreciate the literary labors of those men of science who, in our own and in other countries, are promoting, or have promoted, this result, not only as original discoverers, but also as popular and powerful interpreters of scientific fact, and who, in this latter capacity, have already enriched contemporary literature with writings of rare literary value. If, instead of returning thanks for literature, I were permitted to return thanks on behalf of literature to those writers who have powerfully influenced my own generation, not only by thoughts which stimulate and instruct the intellect, but also by words which stir and elevate the heart, then assuredly I should ask leave to mention some distinguished names which occupy in the field of literature a position only second to the high rank they hold in the hierarchy of science; and foremost among those names I should not hesitate to mention with a special personal gratitude the name of the illustrious man who is the honored guest of this great assembly to-night. I can not say it is as a student of science that I myself have studied the writings of Professor Tyndall, but this I can say, and most truly, that those writings have been to me, from a very early period of my life, companions so cherished that I learned to look upon their writer as a dear personal friend and benefactor long before it was my

privilege to be admitted to his personal intimacy. I believe that scientific research has succeeded in establishing on a physiological basis certain evidences of intelligence even among oysters; and certainly there is, I think, one form of intelligence which is conspicuously displayed by the oyster which might, perhaps, be cultivated with advantage by after-dinner speakers in my position. The oyster knows when to shut up. Admonished by that very interesting and suggestive fact in natural history, what little else I have to say upon behalf of literature, I shall confine to the expression of a hope that the well-deserved relaxation from his more systematic scientific labors in connection with the Royal Institution may enable my valued and honored friend Professor Tyndall to enjoy an increased leisure for the continued cultivation of that department of literature which has already been so richly adorned by his admirable writings."

Sir Lyon Playfair, M. P., proposed the next toast, "The Public Services in Relation to Science." He said that undoubtedly the public services were intimately connected with science, and were profoundly affected by its progress, but, unfortunately, the truth was only beginning to be recognized in this country. In the United States scientific men were attached to all public offices, but in this country the attachment was of the loosest possible character. Nevertheless, science had undoubtedly affected our public services in the most profound way. The telegraph had altered the whole system of commerce, and also the methods and the powers of government. There was to be a great naval review next month; it would be interesting to imagine Elizabeth's thirty small ships, which conquered the Armada, sailing through two miles of modern ironclads. The largest piece of ordnance used in the Crimean War cost less than a single shot fired from the huge guns of our ironclads. But it was in peace rather than in war that science rejoiced in aiding government. A strong feeling was arising that we must improve our intellectual position as a nation, and this, at last, was being recognized by the Government. A material index of progressive civilization had always been desired. Liebig contended that the best index of civilization was the quantity of soap consumed. When the Queen ascended the throne we consumed per head 7¼ pounds of soap, and now we use 10 pounds per head. The consumption of paper was a more reliable index. At the commencement of the Queen's reign the consumption was 1¼ pound of paper yearly; now it was 12 pounds, while in the United States it was 10 pounds, in Germany 9 pounds, in France 8 pounds, and in Italy 4 pounds. But the main question was whether we were developing the national intellect at the same rate as other nations. Our general intelligence is still high, but our trained scientific intelligence is low. Our secondary education in all matters relating to science was far behind that of the United States, Germany, and France. Neither

the Government nor the people governed could go on in simple faith on our practical aptitudes by relying on a blind and vain empiricism, like a tree severed from its roots.

The Earl of Derby.—"My Lords and Gentlemen: You have asked me to return thanks on behalf of the public services in connection with science, and Sir L. Playfair, in relation to that toast, has referred to the increased consumption of soap in this country. I have attended a good many public dinners, and I must say that the expenditure of what is vulgarly called soft soap has been great this evening. I am sincerely grateful to him for the quantity of that article which it has pleased him to expend upon me. But really the toast is one which hardly any man is competent to do justice to, and certainly not one who, like myself, has no connection with science, except a sincere admiration and respect for its professors, and whose connection with the public service has only been that of a parliamentary chief. Under our system the parliamentary head of a department is mainly concerned to keep it in harmony with the House of Commons and with the public. He has to warn the permanent officials that something that is done, or something that is left undone, or proposed to be left undone, is what public opinion will resent; and, on the other hand, he has to tell outsiders that the things they ask him and press him to do are things unwise or impossible from an administrative point of view. That is useful; it is certainly laborious, and it is often a difficult function; but it does not involve much more scientific knowledge than is implied in driving a cab through a crowded street. It does require some knowledge of men, but that is a department of study to which, as yet, no scientific formula has been found to apply. Sir L. Playfair told us, and I was sorry to hear it, of the loose connections which exist between science and the Government. I can only say that I am entirely ignorant of any such immoral transactions. But if the departments were better represented here, and if they could speak for themselves, I am sure that they would not be backward in acknowledging their obligations to science. The Treasury would tell you that those useful though sometimes ungraceful coins in which our dinner is paid for would not circulate through Europe as they do if they had not been subjected to a careful and complicated process, requiring scientific knowledge. The Excise might tell you, if they chose, of the frauds that might be perpetrated upon the revenue and the public if it were not for the careful and scientific examination of all taxable articles. The Post-Office would find no difficulty in acknowledging its obligations to Watt and to Stephenson—for where would postal revenue be without railways?—and in later days to investigators whose researches made the telegraph possible. But the fighting departments, or the spending departments, which is their more common name in Downing Street, would have the most to return thanks for. They

would point to the modern ironclad, the most elaborate, the most complete, and the most costly, of all contrivances in which the art of construction has been utilized for purposes of destruction. They would tell you how the chemist, metallurgist, the engineer, the electrician, the mathematician, have all contributed their share to that extraordinary result of science and skill. The War-Office would follow the Admiralty. They would not say, as Frederick of Prussia did, that Providence is on the side of the biggest battalions, but they might possibly say that Providence was generally on the side of the army which could bring into the field the most scientifically effective weapon in the hands of the most carefully-trained soldier. If I were to turn to the line of business with which I had once something to do, I might ask any diplomatist or any statesman to explain to you how largely the position of Egypt, and, with that, the diplomacy of Europe, has been affected by that little scratch which the genius of M. de Lesseps drew across the Egyptian sands; and if, as is quite possible, the coal-carrying power of steamers and their speed and their economy are largely increased—I do not speak of those wilder predictions according to which steam is to be superseded as the motor power by something more efficient—suppose, I say, the large increase of the coal-carrying power of steamers, and the results to which I have referred may be again reversed; and again, at least in war-time, the route to India may lie through the South African seas. If I speak of the colonies, every one conversant with that department would admit that if we had had the ocean telegraph in existence twenty-five years ago half our little wars beyond the seas would never have taken place, and those that have taken place would have been disposed of in half the time. I know that these things are commonplace, but I can not help that. If I could tell you what the next great discovery was going to be, that would not be commonplace. But, unfortunately, that is not in my power; and if it were, I do not think I should be in a hurry about it, because I have observed that those who are the first to announce a discovery are generally rewarded by having a remarkably unpleasant time. But however great may be the gains which we have derived from the applications of science, they are nothing as compared with those which will and do accrue to us from the acceptance of scientific habits of thought. That is coming already, and it will come more in a not remote future. We have many things in this age and country of which we can not boast, but we may boast that in science England has done something more than hold her own. The great name of Darwin will survive, it may be, the British Empire itself, and with him will be remembered some others also, whom to single out might, perhaps, be invidious. But we may be sure of this, that among their names will be included the name of our distinguished guest of to-night. It is a common complaint that politicians have done nothing for science. In that I do not agree. They have done the best they

could for it—they have let it alone; they have not corrupted it by their intrigues, nor vulgarized it by their squabbles; and they being what they are, and science being what it is, that is probably the best service they could have rendered it.

SOME HUMAN INSTINCTS.*

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II

IN a previous article I passed in review a certain number of those instincts which may be considered fundamental in man. In the pages which follow I propose to complete the list. The reader will perhaps remember my main thesis, which is that man, so far from having an unusually small number of instincts, is more richly endowed in this respect than any other mammal; so richly, indeed, that his instincts often block one another's path. This phenomenon, combined with the transitoriness of many of them, and with what I have called the law of inhibition of instincts by habits, sufficiently account for the indeterminateness of man's conduct in presence of the same objective stimuli—an indeterminateness which has usually been supposed incompatible with his possession of any instincts at all.

The last instinct I touched upon was fear. Let me next say a few words about *appropriation* or *acquisitiveness*. Once more the reader will remember that an instinct is nothing more than an inborn path of reflex discharge in the nervous centers, such that a certain sort of object falling on the senses awakens an impulse to act in a determinate way. The beginnings of acquisitiveness are seen in the impulse which very young children display to snatch at, or beg for, any object which pleases their attention. Later, when they begin to speak, among the first words they emphasize are "me" and "mine."† Their earliest quarrels with each other are about questions of ownership; and parents of twins soon learn that it conduces to a quiet house to buy all presents in impartial duplicate. Of the later evolution of the proprietary instinct I need not speak. Every one knows how difficult a thing it is not to *covet* whatever pleasing thing we see, and how the sweetness of the thing often is as gall to us so long as it is another's. When

* See "The Popular Science Monthly" for June, 1887.

† I lately saw a boy of five (who had been told the story of Hector and Achilles) teaching his younger brother, aged three, how to play Hector, while he himself should play Achilles, and chase him round the walls of Troy. Having armed themselves, Achilles advanced, shouting "Where's my Patroklos?" Whereupon the would-be Hector piped up, quite distracted from his *rôle*, "Where's *my* Patroklos? I want a Patroklos! I want a Patroklos!"—and broke up the game. Of what kind of a thing a Patroklos might be he had, of course, no notion—enough that his brother had one, for him to claim one too.

another is in possession, the impulse to appropriate the thing often turns into the impulse to harm him—what is called *envy*, or *jealousy*, ensues. In civilized life the impulse to own is usually checked by a variety of considerations, and only passes over into action under circumstances legitimated by habit and common consent, an additional example of the way in which one instinctive tendency may be inhibited by others. A variety of the proprietary instinct is the impulse to form collections of the same sort of thing. It differs much in individuals, and shows in a striking way how instinct and habit interact. For, although a collection of any given thing—like postage-stamps—need not be begun by any given person, yet the chances are that if accidentally it *be* begun by a person with the collecting instinct, it will probably be continued. The chief interest of the objects, in the collector's eyes, is that they are a collection, and that they are his. Rivalry, to be sure, inflames this, as it does every other passion, yet the objects of a collector's mania need not be necessarily such as are generally in demand. Boys will collect anything that they see another boy collect, from pieces of chalk and peach-pits up to books and photographs. Out of a hundred students whom I questioned, only four or five had never collected anything. In "The Nation" for September 3, 1886, Professor G. S. Hall gives some account of a statistical research on Boston school-boys, by Miss Wiltse, from which it appears that only nineteen out of two hundred and twenty-nine had made no collections.

The associationist psychology denies that there is any blind primitive instinct to appropriate, and would explain all acquisitiveness, in the first instance, as a desire to secure the "pleasures" which the objects possessed may yield; and, secondly, as the association of the idea of pleasantness with the *holding* of the thing, even though the pleasure originally got by it was only gained through its expense or destruction. Thus the miser is shown to us as one who has transferred to the gold by which he may buy the goods of this life all the emotions which the goods themselves would yield; and who thereafter loves the gold for its own sake, preferring the means of pleasure to the pleasure itself. There can be little doubt that much of this analysis a broader view of the facts would have dispelled. "The miser" is an abstraction. There are all kinds of misers. The common sort, the excessively niggardly man, simply exhibits the psychological law that the potential has often a far greater influence over our mind than the actual. A man will not marry now, because to do so puts an end to his indefinite potentialities of choice of a partner. He prefers the latter. He will not use open fires or wear his good clothes, because the day may come when he will have to use the furnace or dress in a worn-out coat, "and then where will he be?" For him, better the actual evil than the fear of it; and so it is with the common lot of misers. Better to live poor now, with the *power* of living rich, than to live rich at the

risk of losing the power. These men value their gold, not for its own sake, but for its powers. Demonetize it, and see how quickly they will get rid of it! The associationist theory is, as regards them, entirely at fault.

With other misers there combines itself with this preference of the power over the act the far more instinctive element of the simple collecting propensity. Every one collects money, and when a man of petty ways is smitten with the collecting mania for this object he necessarily becomes a miser. Here again the associationist psychology is wholly at fault. The hoarding instinct prevails widely among animals as well as among men. Professor Silliman has thus described one of the hoards of the California wood-rat, made in an empty stove of an unoccupied house: "I found the outside to be composed entirely of spikes, all laid with symmetry, so as to present the points of the nails outward. In the center of this mass was the nest, composed of finely-divided fibers of hemp-packing. Interlaced with the spikes were the following: about two dozen knives, forks, and spoons; all the butcher's knives, three in number; a large carving-knife, fork, and steel; several large plugs of tobacco, . . . an old purse containing some silver, matches, and tobacco; nearly all the small tools from the tool-closets, with several large augers, . . . all of which must have been transported some distance, as they were originally stored in different parts of the house. . . . The outside casing of a silver watch was disposed of in one part of the pile, the glass of the same watch in another, and the works in still another."*

In every lunatic asylum we find the collecting instinct developing itself in an equally absurd way. Certain patients will spend all their time picking pins from the floor and hoarding them. Others collect bits of thread, buttons, or rags, and prize them exceedingly. Now, the "miser" *par excellence* of the popular imagination and of melodrama, the monster of squalor and misanthropy, is simply one of these mentally deranged persons. His intellect may in many matters be clear, but his instincts, especially that of ownership, are insane, and their insanity has no more to do with the association of ideas than with the precession of the equinoxes. As a matter of fact his hoarding usually is directed to money; but it also includes almost anything besides. Lately in a Massachusetts town there died a miser who principally hoarded newspapers. These had ended by so filling all the rooms of his good-sized house from floor to ceiling that his living space was restricted to a few narrow channels between them. Even as I write, the morning paper gives an account of the emptying of a miser's den in Boston by the City Board of Health. What the owner hoarded is thus described: "He gathered old newspapers, wrapping-paper, incapacitated umbrellas, canes, pieces of common wire, cast-off clothing, empty barrels, pieces of iron, old bones, battered tin-ware,

* Quoted in Lindsay, "Mind in Lower Animals," vol. ii, p. 151.

fractured pots, and bushels of such miscellany as is to be found only at the city 'dump.' The empty barrels were filled, shelves were filled, every hole and corner was filled, and in order to make more storage-room, 'the hermit' covered his store-room with a network of ropes, and hung the ropes as full as they could hold of his curious collections. There was nothing one could think of that wasn't in that room. As a wood-sawyer, the old man had never thrown away a saw-blade or a wood-buck. The bucks were rheumatic and couldn't stand up, and the saw-blades were worn down to almost nothing in the middle. Some had been actually worn in two, but the ends were carefully saved and stored away. As a coal-heaver, the old man had never cast off a worn-out basket, and there were dozens of the remains of the old things, patched up with canvas and rope-yarns, in the store-room. There were at least two dozen old hats, fur, cloth, silk, and straw," etc. Of course there may be a great many "associations of ideas" in the miser's mind about the things he hoards. He is a thinking being, and must associate; but, without an entirely blind impulse in this direction behind all the ideas, such practical results could never be reached.*

Kleptomania, as it is called, is an uncontrollable impulse to appropriate, occurring in persons whose "associations of ideas" would naturally all be of a counteracting sort. Kleptomaniacs often promptly restore, or permit to be restored, what they have taken; so the impulse need not be to keep, but only to take. But elsewhere hoarding complicates the result. A gentleman, with whose case I am acquainted, was discovered, after his death, to have a hoard in his barn of all sorts of articles, mainly of a trumpery sort, but including pieces of silver which he had stolen from his own dining-room, and utensils which he had stolen from his own kitchen, and for which he had afterward bought substitutes with his own money.

Constructiveness is as genuine and irresistible an instinct in man as in the bee or the beaver. Whatever things are plastic to his hands, those things he must remodel into shapes of his own, and the result of the remodeling, however useless it may be, gives him more pleasure than the original thing. The mania of young children for breaking and pulling apart whatever is given them, is more often the expression of a rudimentary constructive impulse than of a destructive one. "Blocks" are the playthings of which they are least apt to tire. Clothes, weapons, tools, habitations, and works of art are the result of the discoveries to which the plastic instinct leads, each individual starting where his forerunners left off, and tradition preserving all that once is gained. Clothing, where not necessitated by cold, is noth-

* Cf. Flint, "Mind," vol. i, pp. 330–333; Sully, ibid., p. 567. Most people probably have the *impulse* to keep bits of useless finery, old tools, pieces of once useful apparatus, etc.; but it is normally either inhibited at the outset by reflection, or, if yielded to, the objects soon grow displeasing and are thrown away.

ing but a sort of attempt to remodel the human body itself—an attempt still better shown in the various tattooings, tooth-filings, scarings, and other mutilations that are practiced by savage tribes. As for habitation, there can be no doubt that the instinct to seek a sheltered nook, open only on one side, into which he may retire and be safe, is in man quite as specific as the instinct of birds to build a nest. It is not necessarily in the shape of a shelter from wet and cold that the need comes before him, but he feels less *exposed* and more at home when not altogether uninclosed, than when lying all abroad. Of course the utilitarian origin of this instinct is obvious. But to stick to bare facts at present and not to trace origins, we must admit that this instinct now exists, and probably always has existed, since man was man. Habits of the most complicated kind are reared upon it. But even in the midst of these habits we see the blind instinct cropping out; as, for example, in the fact that we feign a shelter within a shelter, by backing up beds in rooms with their heads against the wall, and never lying in them the other way—just as dogs prefer to get under or upon some piece of furniture to sleep, instead of lying in the middle of the room. The first habitations were caves and leafy grottoes, bettered by the hands; and we see children to-day, when playing in wild places, take the greatest delight in discovering and appropriating such retreats and "playing house" there.

Play.—The impulse to play in special ways is certainly instinctive. A boy can no more help running after another boy who runs provokingly near him, than a kitten can help running after a rolling ball. A child trying to get into its own hand some object which it sees another child pick up, and the latter trying to get away with the prize, are just as much slaves of an automatic prompting as are two chickens or fishes, of which one has taken a big morsel into its mouth and decamps with it, while the other darts after in pursuit. All simple active games are attempts to gain the excitement yielded by certain primitive instincts, through feigning that the occasions for their exercise are there. They involve imitation, hunting, fighting, rivalry, acquisitiveness, and construction, combined in various ways; their special rules are habits, discovered by accident, selected by intelligence, and propagated by tradition; but unless they were founded in automatic impulses, games would lose most of their zest. The sexes differ somewhat in their play-impulses. As Schneider says: "The little boy imitates soldiers, models clay into an oven, builds houses, makes a wagon out of chairs, rides on horseback upon a stick, drives nails with the hammer, harnesses his brethren and comrades together and plays the stage-driver, or lets himself be captured as a wild horse by some one else. The girl, on the contrary, plays with her doll, washes and dresses it, strokes it, clasps and kisses it, puts it to bed and tucks it in, sings it a cradle-song, or speaks with it as if it were a living being. . . . This fact that a sexual difference exists in

the play-impulse, that a boy gets more pleasure from a horse and rider and a soldier than from a doll, while with the girl the opposite is the case, is proof that an hereditary connection exists between the perception of certain things (horse, doll, etc.), and the feeling of pleasure, as well as between this latter and the impulse to play." *

There is another sort of human play, into which higher æsthetic feelings enter. I refer to that love of festivities, ceremonies, ordeals, etc., which seems to be universal in our species. The lowest savages have their dances, more or less formally conducted. The various religions have their solemn rites and exercises, and civic power symbolizes its grandeur by processions and celebrations of divers sorts. We have our operas and parties and masquerades. An element common to all these ceremonial games, as they may be called, is the excitement of concerted action as one of an organized crowd. The same acts, performed with a crowd, seem to mean vastly more than when performed alone. A walk with the people on a holiday afternoon, an excursion to drink beer or coffee at a popular "resort," or an ordinary ball-room, are examples of this. Not only are we amused at seeing so many strangers, but there is a distinct stimulation at feeling our share in their collective life. The perception of them is the stimulus, and the reaction upon it is our tendency to join them and do what they are doing, and our unwillingness to be the first to leave off and go home alone. This seems a primitive element in our nature, as it is difficult to trace any association of ideas that could lead up to it; although, once granting it to exist, it is very easy to see what its uses to a tribe might be in facilitating prompt and vigorous collective action. The formation of armies, and the undertaking of military expeditions would be among its fruits. In the ceremonial games, it is but the impulsive starting-point. What particular things the crowd then shall do, depends for the most part on the initiative of individuals, fixed by imitation and habit, and continued by tradition. The co-operation of other æsthetic pleasures with games, ceremonial or other, has a great deal to do with the selection of such as shall become stereotyped and habitual. The peculiar form of excitement called by Professor Bain the emotion of *pursuit*, the pleasure of a *crescendo*, is the soul of many common games. The immense extent of the play-activities in human life is too obvious to be more than mentioned.†

Curiosity.—Already pretty low down among vertebrates we find that any object may excite attention, provided it be only *novel*, and

* "Der Menschliche Wille," p. 205.

† Professor Lazarus ("Die Reize des Spieles," Berlin, 1883, p. 44) denies that we have an *instinct* to play, and says the root of the matter is the *aversion to remain unoccupied*, which substitutes a sham occupation when no real one is ready. No doubt this is true; but why the particular forms of sham occupation? The *elements* of all bodily games and of ceremonial games are given by direct excito-motor stimulations—just as when puppies chase one another and swallows have a parliament.

that attention may be followed by approach and exploration by nostril, lips, or touch. Curiosity and fear form a couple of antagonistic emotions liable to be awakened by the same outward thing, and manifestly *both* useful to their possessor. The spectacle of their alternation is often amusing enough, as in the timid approaches and scared *wheelings* which sheep or cattle will make in the presence of some new object they are investigating. I have seen alligators in the water act in precisely the same way toward a man seated on the beach in front of them—gradually drawing near as long as he kept still, frantically careering back as soon as he made a movement. Inasmuch as new objects *may* always be advantageous, it is better that an animal should not *absolutely* fear them. But, inasmuch as they may also possibly be harmful, it is better that he should not be quite indifferent to them either, but on the whole remaining on the *qui vive*, ascertain as much about them, and what they may be likely to bring forth, as he can, before settling down to rest in their presence. Some such susceptibility for being excited and irritated by the mere novelty, as such, of any movable feature of the environment must form the instinctive basis of all human curiosity; though, of course, the superstructure absorbs contributions from so many other factors of the emotional life that the original root may be hard to find. With what is called scientific curiosity, and with metaphysical wonder, the practical instinctive root has probably nothing to do. The stimuli here are not objects, but ways of conceiving objects, and the emotions and actions they give rise to are to be classed, with many other æsthetic manifestations, sensitive and motor, as *incidental* features of our mental life. The philosophic brain responds to an inconsistency or a gap in its knowledge, just as the musical brain responds to a discord in what it hears. At certain ages the sensitiveness to particular gaps and the pleasure of resolving particular puzzles reach their maximum, and then it is that stores of knowledge are easiest and most naturally laid in. But these effects may have had nothing to do with the uses for which the brain was originally given; and it is probably only within a few centuries, since religious beliefs and economic applications of science have played a prominent part in the conflicts of one race with another, that they may have helped to "select" for survival a particular type of brain. I shall have to consider this matter of incidental and supernumerary faculties in another place.

Sociability and Shyness.—As a gregarious animal, man is excited both by the absence and by the presence of his kind. To be alone is one of the greatest of evils for him. Solitary confinement is by many regarded as a mode of torture too cruel and unnatural for civilized countries to adopt. To one long pent up on a desert island, the sight of a human footprint or a human form in the distance would be the most tumultuously exciting of experiences. In morbid states of mind, one of the commonest symptoms is the fear of being alone. This

fear may be assuaged by the presence of a little child, or even of a baby. In a case of hydrophobia known to the writer, the patient insisted on keeping his room *crowded* with neighbors all the while, so intense was his fear of solitude. In a gregarious animal, the perception that he is alone excites him to vigorous activity. Mr. Galton thus describes the behavior of the South African cattle whom he had such good opportunities for observing: "Although the ox has little affection for, or interest in, his fellows, he can not endure even a momentary separation from his herd. If he be separated from it by stratagem or force, he exhibits every sign of mental agony; he strives with all his might to get back again, and when he succeeds he plunges into its middle to bathe his whole body with the comfort of closest companionship."*

Man is also excited by the presence of his kind. The *bizarre* actions of dogs meeting strange dogs are not altogether without a parallel in our own constitution. We can not meet strangers without a certain tension, or talk to them exactly as to our familiars. This is particularly the case if the stranger be an important personage. It may then happen that we not only shrink from meeting his eye, but actually can not collect our wits or do ourselves any sort of justice in his presence. "This odd state of mind," says Darwin,† "is chiefly recognized by the face reddening, by the eyes being averted or cast down, and by awkward, nervous movements of the body. . . . Shyness seems to depend on sensitiveness to the opinion, whether good or bad, of others, more especially with respect to external appearance. Strangers neither know nor care anything about our conduct or character, but they may, and often do, criticise our appearance. . . . The consciousness of anything peculiar, or even new, in the dress, or any slight blemish on the person, and more especially on the face—points which are likely to attract the attention of strangers—makes the shy intolerably shy.‡ On the other hand, in those cases in which conduct, and not personal appearance, is concerned, we are much more apt to be shy, in the presence of acquaintances whose judgment we in some degree value, than in that of strangers. . . . Some persons, however, are so sensitive, that the mere act of speaking to almost any one is sufficient to rouse their self-consciousness, and a slight blush is the result. Disapprobation . . . causes shyness and blushing much more readily than does approbation. . . . Persons who are exceedingly shy are rarely shy in the presence of those with whom they are quite familiar, and of whose good opinion and sympathy they are quite assured; for instance, a girl in presence of her mother. . . . Shyness . . . is closely related to fear; yet it is distinct from fear in the ordinary sense. A shy man

* "Inquiries into Human Faculty," p. 72.

† "Expression of the Emotions," New York, 1873, p. 330.

‡ "The certainty that we are well dressed," some lady has said, "gives us a peace of heart to which that yielded by the consolations of religion is as nothing."

dreads the notice of strangers, but can hardly be said to be afraid of them; he may be as bold as a hero in battle, and yet have no self-confidence about trifles in the presence of strangers. Almost every one is extremely nervous when first addressing a public assembly, and most men remain so through their lives." As Mr. Darwin observes, a real dread of definite consequences may enter into this "stage-fright" and complicate the shyness. Even so our shyness before an important personage may be complicated by what Professor Bain calls "servile terror," based on representation of definite dangers if we fail to please. But both stage-fright and servile terror may exist with the most indefinite apprehensions of danger, and, in fact, when our reason tells us there is no occasion for alarm. We must, therefore, admit a certain amount of purely instinctive perturbation and constraint, due to the consciousness that we have become objects for other people's eyes. Mr. Darwin goes on to say: "Shyness comes on at a very early age. In one of my own children, two years and three months old, I saw a trace of what certainly appeared to be shyness directed toward myself, after an absence from home of only a week." Every parent has noticed the same sort of thing. Considering the despotic powers of rulers in savage tribes, respect and awe must, from time immemorial, have been emotions excited by certain individuals; and stage-fright, servile terror, and shyness, must have had as copious opportunities for exercise as at the present time. Whether these impulses could ever have been useful, and selected for usefulness, is a question which, it would seem, can only be answered in the negative. Apparently they are pure hindrances, like fainting at sight of blood or disease, sea-sickness, a dizzy head on high places, and certain squeamishnesses of æsthetic taste. They are *incidental* emotions, in spite of which we get along. But they seem to play an important part in the production of two other propensities, about the instinctive character of which a good deal of controversy has prevailed. I refer to cleanliness and modesty, to which we must proceed, but not before we have said a word about another impulse closely allied to shyness. I mean—

Secretiveness, which, although often due to intelligent calculation and the dread of betraying our interests in some more or less definitely foreseen way, is quite as often a blind propensity, serving no useful purpose, and is so stubborn and ineradicable a part of the character as fully to deserve a place among the instincts. Its natural stimuli are unfamiliar human beings, especially those whom we respect. Its reactions are the arrest of whatever we are saying or doing when such strangers draw nigh, coupled often with the pretense that we were not saying or doing that thing, but possibly something different. Often there is added to this a disposition to mendacity when asked to give an account of ourselves. With many persons the first impulse, when the door-bell rings, or a visitor is suddenly announced, is to scuttle out of the room, so as not to be "caught." When a person at

whom we have been looking becomes aware of us, our immediate impulse may be to look the other way, and pretend we have not seen him. Many friends have confessed to me that this is a frequent phenomenon with them in meeting acquaintances in the street, especially unfamiliar ones. The bow is a secondary correction of the primary feint that we do not see the other person. Probably most readers will recognize in themselves, at least, the *start*, the nascent disposition, on many occasions, to act in each and all of these several ways. That the "start" is neutralized by second thought proves it to come from a deeper region than thought. There is unquestionably a native impulse in every one to conceal love-affairs, and the acquired impulse to conceal pecuniary affairs seems in many to be almost equally strong. It is to be noted that even where a given habit of concealment is reflective and deliberate, its motive is far less often definite prudence than a vague aversion to have one's sanctity invaded and one's personal concerns fingered and turned over by other people. Thus, some persons will never leave anything with their name written on it, where others may pick it up—even in the woods, an old envelope must not be thrown on the ground. Many cut all the leaves of a book of which they may be reading a single chapter, so that no one shall know which one they have singled out, and all this with no *definite* notion of harm. The impulse to conceal is more apt to be provoked by superiors than by equals or inferiors. How differently do boys talk together when their parents are not by! Servants see more of their masters' characters than masters of servants'.* Where we conceal from our equals and familiars, there is probably always a definite element of prudential prevision involved. *Collective* secrecy, mystery, enters into the emotional interest of many games, and is one of the elements of the importance men attach to freemasonries of various sorts, being delightful apart from any end.

Cleanliness.—Seeing how very filthy savages and exceptional individuals among civilized people may be, philosophers have doubted whether any genuine instinct of cleanliness exists, and whether education and habit be not responsible for whatever amount of it is found. Were it an instinct, its stimulus would be dirt, and its characteristic reaction the shrinking from contact therewith, and the cleaning of it

* Thackeray, in his exquisite "Roundabout Paper," "On a Chalk-Mark on the Door," says: "You get truth habitually from equals only; so, my good Mr. Holyshade, don't talk to me about the habitual candor of the young Etonian of high birth, or I have my own opinion of *your* candor or discernment when you do. No. Tom Bowling is the soul of honor, and has been true to Black-eyed Syousan since the last time they parted at Wapping Old Stairs; but do you suppose Tom is perfectly frank, familiar, and above-board in his conversation with Admiral Nelson, K. C. B.? There are secrets, prevarications, fibs, if you will, between Tom and the admiral—between your crew (of servants) and *their* captain. I know I hire a worthy, clean, agreeable, and conscientious male or female hypocrite at so many guineas a year to do so and so for me. Were he other than hypocrite, I would send him about his business."

away after contact had occurred. Now, if some animals are cleanly, men *may* be so, and there can be no doubt that some kinds of matter *are* natively repugnant, both to sight, touch, and smell—excrementitious and putrid things, blood, pus, entrails, and diseased tissues, for example. It is true that the shrinking from contact with these things may be inhibited very easily, as by a medical education; and it is equally true that the impulse to clean them away may be inhibited by so slight an obstacle as the thought of the coldness of the ablution, or the necessity of getting up to perform it. It is also true that an impulse to cleanliness, habitually checked, will become obsolete fast enough. But none of these facts prove the impulse never to have been there.* It seems to be there in all cases; and then to be particularly amenable to outside influences, the child having his own degree of squeamishness about what he shall touch or eat, and later being either hardened or made more fastidious still by the habits he is forced to acquire and the examples among which he lives.

Examples get their hold on him in this way, that a particularly evil-smelling or catarrhal or lousy comrade is rather offensive to him, and that he sees the odiousness in another of an amount of dirt to which he would have no spontaneous objection if it were on his own skin. That *we dislike in others things which we tolerate in ourselves* is a law of our æsthetic nature about which there can be no doubt. But as soon as generalization and reflection step in, this judging of others leads to a new way of regarding ourselves. "Who taught you politeness? The impolite," is, I believe, a Chinese proverb. The concept, "dirty fellow," which we have formed, becomes one under which we personally shrink from being classed; and so we "wash up," and set ourselves right, at moments when our social self-consciousness is awakened, in a manner toward which no strictly instinctive native prompting exists. But the standard of cleanliness attained in this way is not likely to go beyond the mutual tolerance for one another of the members of the tribe, and hence may comport a good deal of actual filth.

Modetsy, Shame.—Whether there be an instinctive impulse to hide certain parts of the body and certain acts, is perhaps even more open to doubt than whether there be an instinct of cleanliness. Anthropologists have denied it, and in the utter shamelessness of infancy and of many savage tribes, have seemed to find a good basis for their views. It must, however, be remembered that infancy proves nothing, and that, as far as sexual modesty goes, the sexual impulse itself works directly against it at times of excitement, and with reference to certain people; and that habits of immodesty contracted with those people,

* The insane symptom called "mysophobia," or dread of foulness, which leads a patient to wash his hands perhaps a hundred times a day, hardly seems explicable without supposing a primitive impulse to clean one's self of which it is, as it were, the convulsive exaggeration.

may forever afterward inhibit any impulse to be modest toward *them*. This would account for a great deal of actual immodesty, even if an original modest impulse were there. On the other hand, the modest impulse, if it do exist, must be admitted to have a singularly ill-defined sphere of influence, both as regards the presences that call it forth, and as regards the acts to which it leads. Ethnology shows it to have very little backbone of its own, and to follow easily fashion and example. Still, it is hard to see the ubiquity of *some* sort of tribute to shame, however perverted—as where female modesty consists in covering the face alone, or immodesty in appearing before strangers unpainted—and to believe it to have no impulsive root whatever. Now, what may the impulsive root be? I believe that, for one thing, it is shyness, the feeling of dread that unfamiliar persons, as explained above, may inspire us withal. Such persons are the original stimuli to our modesty.* But the actions of modesty are quite different from the actions of shyness. They consist of the restraint of certain bodily functions, and of the covering of certain parts; and why do such particular actions necessarily ensue? That there *may* be in the human animal, as such, a "blind" and immediate automatic impulse to such restraints and coverings in respect-inspiring presences, is a possibility difficult of actual disproof. But it seems more likely, from the facts, that the actions of modesty are suggested to us in a roundabout way; and that, even more than those of cleanliness, they arise from the application in the second instance to ourselves of judgments primarily passed upon our mates. It is not easy to believe that, even among the nakedest savages, an unusual degree of cynicism and indecency in an individual should not beget a certain degree of contempt, and cheapen him in his neighbor's eyes. Human nature is sufficiently homogeneous for us to be sure that everywhere reserve must inspire some respect, and that persons who suffer every liberty are persons whom others disregard. "Not to be like such people," then, would be one of the first resolutions suggested by social self-consciousness to a child of nature just emerging from the unreflective state. And the resolution would probably acquire effective pungency for the first time when the social self-consciousness was sharpened into a real fit of shyness by some person being present whom it was important not to disgust or displease. Public opinion would of course go on to build its positive precepts upon this germ; and, through a variety of examples and experiences, the ritual of modesty would grow, until it reached the New England pitch of sensitiveness and range, making us say stomach instead of belly, limb instead of leg, retire instead of go to bed, and forbidding us to call a female dog by name.

* "We often find modesty coming in only in the presence of foreigners, especially of clothed Europeans. Only before these do the Indian women in Brazil cover themselves with their girdle, only before these do the women on Timor conceal their bosom. In Australia we find the same thing happening." (Th. Waitz, "Anthropologie der Naturvölker," vol. i, p. 358). The author gives bibliographical references, which I omit.

At bottom this amounts to the admission that, though in some shape or other a natural and inevitable feature of human life, modesty need not necessarily be an instinct in the pure and simple excito-motor sense of the term.

Love.—Of all propensities, the sexual impulses bear on their face the most obvious signs of being instinctive, in the sense of blind, automatic, and untaught. The teleology they contain is often at variance with the wishes of the individuals concerned; and the actions are performed for no assignable reason but because Nature urges just that way. Here, if ever, then, we ought to find those characters of fatality, infallibility, and uniformity, which, we are told, make of actions done from instinct a class so utterly apart. But is this so? The facts are just the reverse: the sexual instinct is particularly liable to be checked and modified by slight differences in the individual stimulus, by the inward condition of the agent himself, by habits once acquired, and by the antagonism of contrary impulses operating on the mind. One of these is the ordinary shyness recently described; another is what might be called the *anti-sexual instinct,* the instinct of personal isolation, the actual repulsiveness to us of the idea of intimate contact with most of the persons we meet, especially those of our own sex.* Thus it comes about that this strongest passion of all, so far from being the most "irresistible," may, on the contrary, be the hardest one to give rein to, and that individuals in whom the inhibiting influences are potent may pass through life and never find an occasion to have it gratified. There could be no better proof of the truth of that proposition with which we began our study of the instinctive life in man, that irregularity of behavior may come as well from the possession of too many instincts as from the lack of any at all.

The instinct of personal isolation, of which we have spoken, exists more strongly in men with respect to one another, and more strongly in women with respect to men. In women it is called coyness, and has to be positively overcome by a process of wooing before the sexual instinct inhibits it and takes its place. As Darwin has shown in his book on the "Descent of Man and Sexual Selection," it has played a vital part in the amelioration of all higher animal types, and is to a great degree responsible for whatever degree of chastity the human race may show. It illustrates strikingly, however, the law of the inhibition of instincts by habits—for, once broken through with a given person, it is not apt to assert itself again; and habitually broken through, as by prostitutes, with various persons, it may altogether decay. Habit also fixes it in us toward certain individuals: nothing is so particularly displeasing as the notion of close personal contact with those with whom we have long known in a respectful and distant way. The fondness of the ancients and of modern Orientals for forms

* To most of us it is even unpleasant to sit down in a chair still warm from occupancy by another person's body. To many hand-shaking is disagreeable.

of unnatural vice, of which the notion affects us with horror, is probably a mere case of the way in which this instinct may be inhibited by habit. We can hardly suppose that the ancients had by gift of Nature a propensity of which we are devoid, and were all victims of what is now a pathological aberration limited to individuals. It is more probable that with them the anti-sexual impulse toward a certain class of objects was inhibited early in life by *habits* formed under the influence of *example;* and that then a kind of sexual appetite, of which very likely most men possess the germinal possibility, developed itself in an unrestricted way. That the development of it in an abnormal way may check its development in the normal way, seems to be a well-ascertained medical fact. And that the direction of the sexual instinct toward one individual tends to inhibit its application to other individuals, is a law, upon which, though it suffers many exceptions, the whole *régime* of monogamy is based. These details are a little unpleasant to discuss, but they show so beautifully the correctness of the general principles in the light of which our review has been made, that it was impossible to pass them over unremarked.

Jealousy is unquestionably instinctive.

Parental Love is an instinct stronger in woman than in man, at least in the early childhood of its object. I need do little more than quote Schneider's lively description of it as it exists in her:

"As soon as a wife becomes a mother her whole thought and feeling, her whole being, is altered. Until then she had only thought of her own well-being, of the satisfaction of her vanity; the whole world appeared made only for her; everything that went on about her was only noticed so far as it had personal reference to herself; she asked of every one that he should appear interested in her, pay her the requisite attention, and as far as possible fulfill her wishes. Now, however, the center of the world is no longer herself, but her child. She does not think of her own hunger, she must first be sure that the child is fed. It is nothing to her that she herself is tired and needs rest, so long as she sees that the child's sleep is disturbed; the moment it stirs she awakes, though far stronger noises fail to arouse her now. She, who formerly could not bear the slightest carelessness of dress, and touched everything with gloves, allows herself to be soiled by the infant, and does not shrink from seizing its clouts with her naked hands. Now, she has the greatest patience with the ugly, piping cry-baby" (*Schreihals*), "whereas until now every discordant sound, every slightly unpleasant noise, made her nervous. Every limb of the still hideous little being appears to her beautiful, every movement fills her with delight. She has, in one word, transferred her entire egoism to the child, and lives only in it. Thus, at least, it is in all unspoiled, naturally-bred mothers, who, alas! seem to be growing rarer; and thus it is with all the higher animal-mothers. The maternal joys of a cat, for example, are not to be disguised. With an expression of infi-

nite comfort she stretches out her fore-legs to offer her teats to her children, and moves her tail with delight when the little hungry mouths tug and suck. . . .

"But not merely the contact, the mere look of the offspring affords endless delight, not only because the mother thinks that the child will some day grow great and handsome and bring her many joys, but because she has received from Nature an instinctive love for her children. She does not herself know why she is so happy, and why the look of the child and the care of it are so agreeable, any more than the young man can give an account of why he loves a maiden, and is so happy when she is near. Few mothers, in caring for their child, think of the proper purpose of maternal love for the preservation of the species. Such a thought may arise in the father's mind; seldom in that of the mother. The latter feels only . . . that it is an everlasting delight to hold the being which she has brought forth protectingly in her arms, to dress it, to wash it, to rock it to sleep, or to still its hunger."

So far the worthy Schneider, to whose words may be added this remark, that the passionate devotion of a mother—ill herself, perhaps—to a sick or dying child, is perhaps the most simply beautiful moral spectacle that human life affords. Contemning every danger, triumphing over every difficulty, outlasting all fatigue, woman's love is here invincibly superior to anything that man can show.

These are the most prominent of the tendencies which are worthy of being called instinctive in the human species.* It will be observed that no other mammal, not even the monkey, shows so large an array. In a perfectly-rounded development, every one of these instincts would

* Some will, of course, find the list too large, others too small. With the boundaries of instinct fading off into reflex action below, and acquired habit or suggested activity above, it is likely that there will always be controversy about just what to include under the class-name. Shall we add the propensity to walk along a curbstone, or any other narrow path, to the list of instincts? Shall we subtract secretiveness, as due to shyness or to fear? Who knows? Meanwhile our physiological method has this inestimable advantage, that such questions of limit have neither theoretical nor practical importance. The facts once noted, it matters little how they are named. Most authors give a shorter list than that in the text. The phrenologists add adhesiveness, inhabitiveness, love of approbation, etc., etc., to their list of "sentiments," which in the main agree with our list of instincts. Fortlage, in his "System der Psychologie," classes among the *Triebe* all the vegetative physiological functions. Santlus ("Zur Psychologie der Menschlichen Triebe," Leipsic, 1864) says there are at bottom but three instincts, that of "Being," that of "Function," and that of "Life." The "Instinct of Being" he subdivides into *animal*, embracing the activities of all the senses; and *psychical*, embracing the acts of the intellect and of the "transempiric consciousness." The "Instinct of Function" he divides into *sexual*, *inclinational* (friendship, attachment, honor); and *moral* (religion, philanthropy, faith, truth, moral freedom, etc.). The "Instinct of Life" embraces *conservation* (nutrition, motion); *sociability* (imitation, juridical and ethical arrangements); and *personal interest* (love of independence and freedom, acquisitiveness, self-defense). Such a muddled list as this shows how great are the advantages of the physiological analysis we have used.

start a habit toward certain objects and inhibit a habit toward certain others. Usually this is the case; but, in the one-sided development of civilized life, it happens that the timely age goes by in a sort of starvation of objects, and the individual then grows up with gaps in his psychic constitution which future experiences can never fill. Compare the accomplished gentleman with the poor artisan or tradesman of a city: during the adolescence of the former, objects appropriate to his growing interests, bodily and mental, were offered as fast as the interests awoke, and, as a consequence, he is armed and equipped at every angle to meet the world. Sport came to the rescue and completed his education where real things were lacking. He has tasted of the essence of every side of human life, being sailor, hunter, athlete, scholar, fighter, talker, dandy, man of affairs, etc., all in one. Over the city poor boy's youth no such golden opportunities were hung, and in his manhood no desires for most of them exist. Fortunate it is for him if gaps are the only anomalies his instinctive life presents; perversions are too often the fruit of his unnatural bringing up.

PHYSIOLOGY OF FREEZING.

By Dr. von NUSSBAUM.

SERIOUS ills often result from exposure to freezing, merely because many people do not know how to guard against troubles so induced. Delicate white faces are sometimes disfigured by the nose turning red; this is liable to happen to one who has suffered from freezing of the organ, usually at the first snow-fall, perhaps even in midsummer; the hands may display, at these times, bluish-red and swollen fingers, and all this only because at some time in early youth, when these members had become frozen, proper care was not taken of them, and because there was nobody at hand who could offer sound advice. Chilblains, when wrongly treated, become very troublesome, and may lead to the loss of fingers or toes by mortification; and such an occurrence can even endanger life. If, during intense cold, we are subjected to influences that tend to lower our vitality, we may fall into a sleep, from which perhaps we may never awake.

No man knows in what circumstances he may at some time be placed. The courageous soldiers who, with Napoleon I, left the burning city of Moscow, probably never dreamed, while in sunny France, that they would sink down on snow-banks, and fall into a sleep that ends but in death! Many of them could perhaps have saved their lives if they had ever heard of the proper precautions to be taken against this danger. Some persons think that the drinking of strong liquor will enable them to resist the cold more readily; this, however, is very delusive. Even if we increase the activity of some organs by a

stimulating drink, we must not forget that the taking of liquor causes the blood to rush to the brain, and that the cold, too, drives the blood from the skin to the inner organs, and particularly to the brain. Strong drink must, therefore, favor the congestion of the brain which is caused by cold.

Good nourishment, an energetic character, and a sound heart, are the best preventives against the danger of perishing by cold. Close-fitting garments, which impede the circulation of the blood, and exposure in damp, windy weather should, if possible, be carefully avoided.

Many persons have the idea that life is endangered *only*, if the patient be brought too suddenly from the cold into a warm place. They believe that, if one proceed very carefully and slowly with the warming, the cold can never produce a lasting injury to the system. There is certainly no doubt that sudden warming is very dangerous, and that a great deal depends upon the right treatment of the frozen limb. Experience shows that, while some people have frozen joints treated in such a manner that they are completely restored, others are less fortunate, and suffer frequently in after-years. But one must admit that intense cold alone, without being followed by sudden warming, which proves so disastrous, suffices to cause severe suffering. In this respect, a great deal depends on the nature of the person. If very sudden transitions from heat to cold and from cold to heat be avoided, a healthy person can withstand intense cold without serious consequences, especially if he be mentally active, energetic, and muscular, and has a sound heart—that is, if his pulse be regular and strong. A robust person can withstand the temperature at which alcohol and mercury freeze. Members of north-pole expeditions have experienced temperatures of fifty or more degrees below zero without suffering harm.

However, it happens not unfrequently that even moderately cold weather, when the thermometer is but a few degrees below the freezing-point, causes serious ills, and sometimes even fatal results. This is apt to happen to persons who are anæmic, poorly fed, effeminate, or mentally depressed. Old men, children, anæmic girls, drunkards, and people with a weak heart, are all liable to be frost-bitten, and easily freeze to death if they succumb to sleep while exposed to intense cold. They fall into a sort of stupor, sit down to rest, soon fall asleep, and in most instances never awake. For a long time they remain in a condition bordering on death; they breathe a little, and the heart makes feeble attempts to maintain the circulation of the blood.

This beating of the heart is the cause of the long duration of this death-like trance. The heart exerts a slight pressure on the lungs, and causes thereby a sort of artificial breathing, which, however, is so slight that laymen and even physicians often erroneously consider people who are merely frozen to be dead.

When Napoleon I had returned to France from Russia, he felt

convinced that many of his soldiers had been buried alive, and he offered a large reward for the surest means of distinguishing between this trance-like condition and actual death. The prize was awarded to Professor Andral, who claimed that listening to the heart-sounds by means of the stethoscope was the surest way of ascertaining whether death had taken place or not, because with this instrument could still be heard the movement of the heart-valves, when by all other tests one could no longer detect any sign of life. Napoleon's prize might, however, well have been awarded to Professor Middeldorf, of Breslau, who with his *akidopeirastic* (needle-test) was able to detect signs of life some time after the sound caused by the movement of the heart-valves had ceased to be audible with Andral's stethoscope.

Up to the present day this method is the most reliable one for ascertaining whether death has occurred or not. It is surer than the cutting of the sole, the burning with sealing-wax, or any other test. A long needle is thrust (between the fifth and sixth ribs) into the heart, a proceeding that is not at all dangerous, provided that the needle does not enter below a certain depth. The needle must be of such length that about one half of it projects from the chest; the slightest movement of the heart will cause that part of the needle which is visible to vibrate.

But no one need fear that those soldiers of Napoleon who were thus buried alive ever awakened in their graves. As surely as there can be no question but that by careful treatment quite a number of them could have been saved, just as confidently can it be asserted that their numbness, provided no careful attempts were made to restore them to life, resulted in actual death. Unfortunately, it has not yet been ascertained how long this trance-like condition may last with the frozen—whether five or six days (many such cases are known), or whether it may not continue even longer.

We have already, at the beginning, referred to the danger of an incautious warming of the frozen. If the warming be accomplished too quickly, a sudden reaction will set in, which the patient will not be able to survive. Blood which has been frozen and then thawed is still red, but of a different shade. The coloring matter of the blood has become separated from the blood-cells. Blood of this description causes congelation in blood which is in its normal state. One can kill an animal in sound health by injecting such blood into its veins. But the process takes a different turn in cases where the frozen are *gradually* warmed and restored. If a very minute quantity of the frozen blood is again brought into solution and sent into the system, this small amount of poison will be taken care of. This is the reason why, in all attempts at revivifying persons who have been frozen, the warming and the restoring of the juices to their normal condition must be gradually done. The best way is to lay the patient into snow, to rub him with snow (which should be renewed several times), and then to

follow this treatment up with very cold water. Then give a cold bath in an unheated room, rub the chest and the region of the heart thoroughly with fresh water, and finally put the patient into a cold bed, cover him with cold cloths, and give an enema of cold water.

Some blow fresh air into one of the nostrils by means of bellows, while the other nostril and the mouth are kept firmly closed. But, as far as my experience goes, by this treatment the air is much more likely to get into the stomach than into the lungs. If it is necessary to induce artificial respiration, it is better to alternately press the arms of the patient firmly to his chest and then to raise them above his body, or, what is even more simple, squeeze together every two or three seconds both chest and abdomen with the hands.

As soon as faint signs of life, such as a twitching of the eyes, a change in the color of the lips, or an attempt at breathing are noticed, the nose should be tickled with a feather, and a few drops of some stimulating fluid, either wine, brandy, or ammonia, should be poured into the mouth and throat. When the symptoms of returning life become more marked, pour a few teaspoonfuls of one of the above-mentioned liquids into the mouth and give an injection with a spoonful of wine or brandy, and also use one of the liquids to rub the skin; then put the patient into a warm bed. After this, some warm soup or a cup of coffee will be in place. Should the excitement become too great, it is advisable to give a lukewarm bath and some soothing potion.

In the every-day happenings of our life such accidents occur but rarely. However, complaints of frozen fingers, toes, ears, and noses, and chilblains, are frequent.

Many people think that fingers, toes, and noses are apt to be frozen because they are so distant from the heart, and are in consequence not so plentifully supplied with warm blood. Although I do not wish to dispute this entirely, the main reason seems to be that these parts are very thin and small and come more directly in contact with the air. When such small parts are exposed to intense cold, the veins contract and drive the blood toward the interior. The backs of the fingers and toes freeze first; they become pale and devoid of feeling, and the joints benumbed and stiff. After a while the blood in the veins congeals, all tissues grow brittle and break easily. But frozen joints are not dead. If gradually warmed they can be restored entirely; if, however, they have been exposed to intense cold and are then suddenly warmed, a strong inflammatory reaction sets in, the same as when normally warm parts are exposed to a temperature as high as that of boiling water. Cold alone can produce numbness and insensibility; but an inflammatory reaction is alone due to too rapid a warming. To such careless treatment only must the troubles which are known as frozen joints, chilblains, etc., be ascribed. Chilblains, where the skin and tissues are inflamed, cause a disagreeable itching in warm weather.

The first stage of such an inflammation makes the joints appear bluish-red, violet, and swollen. Frozen joints are at the beginning cold and difficult to move; they cause a stinging pain, particularly in the evening during damp, cold weather. During spring and summer the trouble often disappears entirely, but sometimes it appears even in midsummer. During the first winter the pains are more severe than in the following years.

A *second* and more advanced stage of localized freezing takes place where the cold was more intense, or where the organs were subjected to a more sudden warming. All symptoms are then more severe; the skin of the fingers cracks, and painful cuts, blisters, and sores result.

As the *third* stage of freezing, those instances are denoted where the frozen joints become immediately mortified, or where they are at first greatly inflamed and then become mortified. The mortification, however, rarely penetrates deeply; it is mostly restricted to the outer skin, which turns gray, black, and dry. Beneath this superficial mortification there is generally found an ulcer that can be cured.

When a frozen joint grows warm, and the congealed blood again becomes liquid, the blood can enter for a time into the open vessels; then the question arises if the blood-vessels and the tissues can perform the necessary transformation, or whether, as we have already suggested, the blood which had been frozen will act as a poison, induce the normal blood to congeal, and interrupt its circulation. This will then give rise to an insufficient supply, and will even induce dangerous poisoning. This is no doubt the main reason why the sudden warming of frozen individuals or frozen joints proves to be so dangerous.

The best advice, and the counsel to be given, above all, is, guard against freezing! In looking over what has been said so far, the best safeguard against this danger proves to be a strong, healthy, well-nourished body and a sound heart. Furthermore, for very cold weather, warm, common-sense clothing, which does not fit closely, and hence does not impede the circulation of the blood, is to be recommended.

Dresses of woolen goods are naturally warmer than those of linen or silk, the latter being better conductors of heat. During intensely cold weather, particularly when a dry wind is blowing, woolen gloves will not be amiss.

A certain robustness of health should be acquired by every one, and effeminacy of any kind should be avoided. Healthy children should go out in any kind of weather, and they should be rendered more hardy by cold washings daily. On wet days, if garments and shoes become damp, they should be replaced by dry ones immediately on returning home.

But if one has actually met with the misfortune of having a joint

frozen, so that it is white, stiff, cold, and devoid of feeling or power of motion, the principal advice, not to be forgotten, is, not to warm the frozen part too quickly; rub the joint in a cold room with snow or ice until some sensibility returns; then rub it with cold water, and wrap it up in fine linen rags, which should be moistened with a mixture of five parts of Goulard's solution and one part of spirits of camphor, and then tie it up in a rubber sheeting or oiled silk. Quite useful, too, will prove, after some feeling has returned, a hand or a foot bath with bleaching-powder. For this purpose a tablespoonful of bleaching-powder is dissolved in a basin of cold water. In order to be sure of doing everything that can be done, on going to bed at night, wrap up the frozen joints in flannel, and drink something that will cause perspiration.

If a hand or foot, even though it may have been entirely frozen, be rubbed with snow until the return of feeling, and is then at night brought into perspiration, the injury will in most cases have been entirely cured, and no relapse need be feared.

The few directions that have here been given will, if carefully followed, suffice. Of course, there are legions of cures and curatives that are recommended for frozen joints. These, however, are in place only where, through careless treatment, after-effects of the freezing, such as ulcers, chilblains, etc., remain. The frequent occurrence of such ills proves how rarely a frozen joint has received the right attention in the first place, when it would have been entirely restored.

There are some physicians who believe it impossible to prevent chilblains when a joint has once been frozen. It is, of course, true that severe cases of freezing will occur where even the best of care is powerless to prevent serious trouble, and which may sometimes even involve the loss of some part of the frozen joint.

All things considered, however, it may be said that one can guard against permanent injuries through frost if the right treatment be adopted immediately after the freezing has occurred; and even that those injuries which have been caused by too rapid a warming and other wrong treatment can be materially improved by attentive and correct care.

For the removal of those red spots which appear principally on the nose, and which may prove quite disfiguring, we used to employ hot-water vapors, followed by washings with a solution of dilute hydrochloric acid (one to six), or a solution of bleaching-powder in water. Lately, however, I advise, and with better results, the application of hot-water vapors, and at night the putting on of a salve made up of one part of ichthyol and eight parts of vaseline.

Unfortunately, the ichthyol has a brown color, but this can easily be removed in the morning by using warm water and soap. If any one is particularly sensitive respecting his appearance, he may repeat the treatment with the ichthyol in the morning, after having employed

the water-vapor, thus using the remedy twice in twenty-four hours, which will materially hasten the desired effect.

Among the large number of things that have been recommended, each one has its peculiarities; some natures derive more benefit from the one; others, again, from another, a fact which makes it advisable to leave the choice of the agent to be used to some physician who is acquainted with the constitution of the patient; for all agents which are powerful and useful may cause great injury if indiscreetly applied. —*Translated for the Popular Science Monthly from Die Gartenlaube.*

SKETCH OF J. J. AUDUBON.

WHEN Audubon's fame was just beginning, "Christopher North" (Professor Wilson, of the University of Edinburgh, and editor of "Blackwood's Magazine") wrote, under the form of a dialogue between himself and the Ettrick Shepherd (James Hogg, the poet), as follows:*

"*North.* What a pity, James, that you were not in Edinburgh in time to see my friend Audubon's exhibition!

"*Shepherd.* An exhibition o' what?

"*North.* Of birds painted to the life. Almost the whole American ornithology, true to nature as if the creatures were in their native haunts in the forests, or on the sea-shores. Not stiff and staring like stuffed specimens, but in every imaginable characteristic attitude, perched, wading, or a-wing—not a feather, smooth or ruffled, out of its place—every song, chirp, chatter, or cry made audible by the power of genius.

"*Shepherd.* Where got he sae weel acquaint wi' a' the tribes—for do they not herd in swamps and woods where man's foot intrudes not—and the wilderness is guarded by the rattlesnake, fearsome watchman, wi' nae ither bouets than his ain fiery eyne?

"*North.* For upward of twenty years the enthusiastic Audubon lived in the remotest woods, journeying to and fro on foot thousands of miles—or sailing on great rivers, great as any seas—with his unerring rifle, slaughtering only to embalm his prey by an art of his own, in form and hue unchanged, unchangeable—and now, for the sum of one shilling, may anybody that chooses it behold the images of all the splendid and gorgeous birds of that continent.

"*Shepherd.* Where's the exhibition now?

"*North.* At Glasgow, I believe—where I have no doubt it will attract thousands of delighted spectators. I must get the friend who gave a glance over 'Selby's Ornithology' to tell the world at large

* "Noctes Ambrosianæ" ("Blackwood's Magazine"), No. XXX, January, 1827.

more of Audubon. He is the greatest artist in his own walk that ever lived, and can not fail to reap the reward of his genius and perseverance and adventurous zeal in his own beautiful branch of natural history, both in fame and fortune."

JOHN JAMES AUDUBON was born near New Orleans, May 4, 1780, and died at the present Audubon Park, New York city, January 27, 1851. His father, the son of a fisherman of La Vendée, was a French naval officer, who, having become wealthy, had acquired a plantation in Louisiana, and married a lady of that colony, of Spanish descent. The son imbibed a love of Nature at an extremely early age, which was probably strengthened by his short residence on his father's plantation in Santo Domingo, and was not repressed, but mastered the situation when he was sent to France to be educated. It is recorded of him that he was accustomed to amuse himself when a mere child by trying to draw the birds he saw around him; and that, his crude efforts not being satisfactory, he used to make a bonfire of them at each birthday. His father desired him to be qualified for some occupation connected with the navy, or with engineering. He was sent to France, where the father had bought an estate near Nantes, on which his step-mother was living, to be taught mathematics, drawing, geography, fencing, and music. His drawing-master was the celebrated artist David, who set him to drawing "horses' heads and the limbs of giants," but he preferred birds, and improved such opportunities as he could get to exercise himself upon them, and spent much of his time in excursions into the woods, collecting specimens, and making drawings of them. The real supervision of his operations was with his indulgent step-mother, who gave him ample scope for the exercise of his own tastes. When Audubon's father returned from sea he was astonished at the large collection his son had made, and then asked what progress he had made in his other studies. The reply not being satisfactory, he took the youth in hand himself, and kept him for a year in the close study of mathematics. But every opportunity for natural history rambles was still improved. Audubon spent another year at Nantes, when he went over after having returned to America, and settled at Mill Grove, to expose the unfaithfulness of an agent whom his father had intrusted with the charge of one of his enterprises, and to consult his parents respecting marriage. During one of these residences in Nantes he is credited with having made a hundred drawings of European birds. Three specimens of these works have recently come into the hands of Dr. R. W. Shufeldt, who has described them in "The Auk." They are all drawn in a combination of crayon and water-colors, on a thin and not expensive kind of drawing-paper; are numbered 44, 77, and 96, and represent the magpie, the coot, and the green woodpecker. The earliest of the sketches is the magpie, represented as of life-size and standing on the ground. "The execution is quite crude, though the naturalist 'sticks out' in it, for, not-

withstanding the somewhat awkward position the bird is in, there is life in it." The second picture, that of a coot, "is a marked improvement on the magpie. Far more pains have been taken with the feet, legs, bill, and eye, though little has been gained in the natural attitude of the bird. . . . Except very faintly in the wing, no attempt has been made to individualize the feathers, the entire body being of a dead black, worked in either by burned cork or crayon." Dr. Shufeldt also remarks that, "as is usually the case among juvenile artists, both this bird and the magpie are represented upon direct lateral view, and no evidence has yet appeared to hint to us of the wonderful power Audubon eventually came to possess in figuring his birds in their every attitude." The green woodpecker "is a wonderful improvement, in every particular, upon both of the others. The details of the plumage and other structures are brought out with great delicacy, and refinement of touch; while the attitude of the bird, an old male, is even better than many of those published in his famous work. The colors are soft, and have been so handled as to lend to the plumage a very flossy and natural appearance, while the old trunk, upon the side of which the bird is represented, presents several evidences of an increase of the power to paint such objects."

When about seventeen or eighteen years old, young Audubon returned to the United States, and his father, willing to gratify his now decided tastes, settled him upon a farm which he owned near Philadelphia, "Mill Grove," at the mouth of Perkiomen Creek. Here he had full opportunity for the gratification of his huntsman's and naturalist's inclination, and improved it so industriously that he appeared to be good for little else. Desiring to form a matrimonial engagement with Lucy Bakewell, he was advised by the father of the young lady to go into business, and he accordingly entered the employment of a firm in New York; but even here it was the study of Nature and not trade that engaged his attention. "For a period of twenty years," he confesses in the biographical preface to his "Birds," "my life was a series of vicissitudes. I tried various branches of commerce, but they all proved unprofitable, doubtless because my whole mind was ever filled with my passion for rambling and admiring those objects of Nature from which alone I received the purest gratification." It is in connection with the relation of the story of a hurricane, while he was living at Henderson, years after his Philadelphia experiences, that he says that, just before the breaking out of the awful storm, his thoughts were, "for once, at least, in the course of my life, entirely engaged in commercial speculations." He soon gave up his New York engagement, and shortly afterward formed a partnership with Ferdinand Rosier to go into trade at Louisville, Kentucky. His settlement at this place having been determined upon, he was married to Miss Bakewell in April, 1808. This lady was a descendant of the Peverils of the Peak, one of whom has given name to

one of Walter Scott's novels, and was a relative of the famous British geologist Bakewell. She proved a congenial wife to the naturalist, and gave him valuable aid while he had his great work under way, by helping him to pay the expenses of his enterprise out of the fruits of her own industry. The farm at Mill Grove was sold, a stock of goods was purchased with the proceeds, and Audubon removed with his wife to Louisville, making the journey down the Ohio River in a flat-boat, with two rowers. At Louisville, again, he left business to his partner, and occupied himself with natural history and his drawings.

In 1810 he was visited at his store by Alexander Wilson, who came to solicit subscriptions to his "Ornithology." He was about to sign the list, when his partner suggested to him, in French, that he could make better drawings than Wilson, and probably knew as much about American birds as he. Wilson understood the remark, and asked Audubon if he had any drawings of birds. Audubon exhibited what he had, and, to Wilson's question if he intended to publish his work, replied that he had never thought of it. The two naturalists seem to have spent some time together. Audubon explored the woods with Wilson, lent him his drawings, and aided him in various ways; but, after all this, Wilson, in the mortification of his vanity that he had met a superior in his own special field, had it in his heart to enter in his notes against Louisville that "science or literature had not one friend in the place."

As might be expected, the business at Louisville was not prosperous. After four years, marked by two removals to secure better success, the partnership was dissolved, and Audubon removed to Henderson, Kentucky, in 1812. Another business adventure, entered into with his brother-in-law in New Orleans, failed. Only natural history prospered with him. A very large proportion of his work in this line, which bore so noble and so abundant fruit in later years, was done during his residence in Henderson. Aiming to represent the birds which he drew in position as far as possible, he adopted ingenious devices to secure correct views of them as they looked in Nature. Those which he had to shoot he would afterward set up and support in natural attitudes, while he painted them; others he would view, with their actual surroundings, through a telescope. Audubon's father died about 1812, leaving to him the estate in France and seventeen thousand dollars, which had been deposited with a merchant in Richmond, Virginia. "Audubon, however, took no steps to obtain possession of his estate in France, and in after-years, when his sons had grown up, sent one of them to France for the purpose of legally transferring the property to his own sister Rosa." Before Audubon was able to obtain the money from the merchant in Richmond, the latter died insolvent; and so no benefit accrued to the naturalist from either part of his legacy.

By the pressure of this disappointment and other failures, Audubon

was compelled to work for a living. He took up the drawing of crayon-portraits with much success, and is said to have seemed to get a new start in life. In a short time he received an invitation to become a curator of the museum at Cincinnati, and for the preparation of birds received a liberal remuneration. In conjunction with this situation he opened a drawing-school in the same city, and obtained from this employment additional emolument sufficient to support his family comfortably. His teaching succeeded well until several of his pupils started on their own account. The work at the museum having been finished, Audubon fell back upon his portrait-painting and such resources as his genius could command. Applying for assistance to an old friend whom he had helped into business, the ungrateful wretch declared he would do nothing for his benefactor, and further added that he would not even recommend one who had such wandering habits. On more occasions than this his genius for discovery was made an argument against him.

In October, 1820, Audubon left Cincinnati, and sailed down the Ohio in company with Captain Cumming, an engineer, who had been appointed to make a survey of the Mississippi River. He was provided with letters of introduction from General Harrison and Henry Clay, and intended a long ornithological excursion through Mississippi, Alabama, and Florida, up Red River, and down the Arkansas. At Bayou Sara, in the following June, he accepted an engagement with Mrs. Perrie to teach her daughter drawing during the summer months at sixty dollars a month. Mrs. Perrie's real aim is supposed to have been to provide for Audubon an opportunity to carry on his pursuits under the guise of an employment which would be congenial and not interfere with his work. Later in the year he was invited to join another artist in painting a panorama of New Orleans. But, he wrote in his journal, "My birds, my beloved birds of America, occupy all my time, and nearly all my thoughts, and I do not wish to see any other perspective than the last specimen of those drawings."

For the first two months of 1822 it is written by his wife in her "Life," "the records of Audubon's life are sparse and imperfect, on account of his inability to purchase a book to write his journal in!" The one at last obtained was made of thin, poor paper, and the records entered are rather in keeping with his financial difficulties. It took all his means at this time to supply his family with the necessaries of life; and in order to obtain money to educate the children, his wife undertook the duties of a situation in which she had charge of and educated the offspring of a Mr. Brand. They afterward removed to Natchez, where Audubon drew and taught drawing in the college at Washington, Mississippi, and Mrs. Audubon taught; and then to Bayou Sara, Louisiana, where Mrs. Audubon established a school, with the proceeds of which she was enabled to aid materially in the publication of the "Birds," and Audubon assisted her by teaching music and dancing. A member of one

of the families, in which Mrs. Audubon was a governess during this period, has furnished Dr. Shufeldt with a childhood's reminiscence of the naturalist. "He was with us," she says, "eight months, but during the greater part of the time was wandering all over the State, walking almost the entire time; no insect, worm, reptile, bird, or animal escaped his notice. He would make a collection, return home and draw his crayon-sketches, when his son John would stuff the birds and such animals as he wished to preserve."

In the spring of 1824, Audubon, with two hundred drawings, representing about a thousand birds, went to Philadelphia in order obtain help to complete his ornithological work. He was soon satisfied, it is said in Mrs. Audubon's "Life," that the venture would be successful. Having purchased a new suit of clothes and dressed himself with extreme neatness, he called upon Dr. Mease, an old friend, and was introduced by him to several artists, who paid him pleasant attentions. He was also introduced to Prince Canino, son of Lucien Bonaparte, "who examined my birds," Audubon writes, "and was complimentary in his praises. He was at the time engaged on a volume of American birds, which was soon to be published; but this did not prevent him from admiring another naturalist's work.—*April 12th.* Met the prince at Dr. Mease's, and he expressed a wish to examine my drawings more particularly. I found him very gentlemanly. He called in his carriage and took me to Peale, the artist, who was drawing specimens of birds for his work; but from want of knowledge of the habits of birds in a wild state, he represented them as if seated for a portrait, instead of their own lively, animated ways when seeking their natural food or pleasure. Other notable persons called to see my drawings, and encouraged me with their remarks. The Prince Canino introduced me to the Academy of Arts and Sciences, and pronounced my birds superb and worthy of a pupil of David. I formed the acquaintance of Le Sueur, the zoölogist and artist, who was greatly delighted with my drawings." Audubon was engaged by Prince Canino to superintend his drawings intended for publication; but his terms being much dearer than Alexander Wilson's, he was asked to discontinue his work. "I had now," he writes, "determined to go to Europe with my 'treasures,' since I was assured nothing so fine in the way of ornithological representations existed. I worked incessantly to complete my series of drawings. On inquiry, I found Sully and Le Sueur made a poor living by their brush. I had some pupils offered at a dollar per lesson; but I found the citizens unwilling to pay for art, although they affected to patronize it. I exhibited my drawings for a week, but found the show did not pay, and so determined to remove myself."

Thus, notwithstanding the pleasant social aspect of his reception in Philadelphia, he does not appear to have been encouraged in its material promise; and he met with a misfortune which would have depressed the spirits of the bravest and most sanguine. His plates,

the fruit of years of labor and of almost exclusive preoccupation during the whole time, were destroyed in a single night by rats. He went to work at once, however, to restore his drawings, and did so. Mr. McMurtrie, the conchologist, advised him to take his drawings to England. Prince Canino advised him to go to France. He proceeded to New York, having left Philadelphia "free from debt and free from anxiety about the future." In New York he visited the museum and "found the specimens of stuffed birds set up in unnatural and constrained attitudes. This appears to be the universal practice, and the world owes to me the adoption of the plan of drawings from animated nature. Wilson is the only one who has in any tolerable degree adopted my plan."

The prospect for having his drawings published in New York did not appear very encouraging, although it seemed more hopeful than it had been in Philadelphia. He visited the Lyceum, and his portfolio was examined by the members of the Institute, among whom, he writes, "I felt awkward and uncomfortable." After living among such people I felt clouded and depressed; remember that I have done nothing, and fear that I may die unknown. I feel I am strange to all but the birds of America. In a few days I shall be in the woods and quite forgotten." On the next day: "My spirits low, and I long for the woods again; but the prospect of becoming known prompts me to remain another day." He was invited by the artist, Vanderlyn, to sit for a portrait of General Jackson, whom his figure was thought to resemble considerably.

From New York he proceeded up the Hudson and into the lake-region, visiting Niagara, but not crossing over to Goat Island on account of the low state of his finances; then returned by way of Erie, Pittsburg, and the rivers, to his home in Bayou Sara. His wife was receiving an income of nearly three thousand dollars a year from her labors in teaching, and he took charge of a class in dancing by which he cleared two thousand dollars; and with this capital and his wife's savings he was now able to foresee a successful issue to his great ornithological work.

He had determined upon going to England where, although he knew no one, he hoped that he might find a way to get his plates engraved. He sailed from New Orleans in May, 1826, and arrived in Liverpool on the 20th of July. He exhibited his pictures, with satisfaction to his visitors at Liverpool and Manchester, to their admiration at Edinburgh. He made friends of Herschel, Sir Walter Scott, and "Christopher North," who has left the record of his warm admiration for the man and his work in two of his essays, and of Cuvier, Humboldt, and Saint-Hilaire in France. He resolved to go on with the publication of his works, although his friends advised him that the risk was too great to venture upon. In 1827 he issued the prospectus of "The Birds of America," to be published in numbers of

five folio plates each, the whole to be included in four volumes, and to be sold for one thousand dollars a copy. The entire cost of the work would exceed one hundred thousand dollars; yet when the prospectus was published he had not money enough to pay for getting out the first number. With the aid of Sir Thomas Lawrence he sold some pictures, and was enabled to carry himself over this difficulty; and this led the way to his finding a regular means of support while his enterprise was going on, by painting. He visited Paris in 1828, canvassing for subscribers, and experienced an admiration from illustrious men parallel with that which had greeted him in England. But he does not appear to have appreciated the money value of this admiration as highly as what he found in England, for he wrote: "France is poor indeed! This day I have attended the Royal Academy of Sciences, and had my plates examined by about one hundred persons. 'Fine, very fine,' issued from many mouths; but they said, also, 'What a work! what a price! who can pay it?' I recollected that I had thirty subscribers at Manchester, and mentioned it. They stared and seemed surprised; but acknowledged that England, the little island of England, alone was able to support poor Audubon. . . . Now it is that I plainly see how happy, or lucky, it was in me not to have come to France first; for if I had, my work now would not have had even a beginning. It would have perished like a flower in October; and I should have returned to my woods, without the hope of leaving behind that eternal fame which my ambition, industry, and perseverance long to enjoy." Baron Cuvier was requested by the Academy of Sciences to make a verbal report on Audubon's "Birds," and he responded, describing the work "as the most magnificent monument which has yet been erected to ornithology." The author, having returned to his own country after his schooling in France, "thought he could not make a better use of his talents than by representing the most brilliant productions of that hemisphere. The accurate observation necessary for such representations as he wished to make soon rendered him a naturalist. . . . Formerly the European naturalists were obliged to make known to America the riches she possessed; but now Mitchell, Harler, and Bonaparte give back with interest to Europe what America had received. Wilson's history of the 'Birds of the United States' equals in elegance our most beautiful works on ornithology. If that of Mr. Audubon should be completed, we shall be obliged to acknowledge that America, in magnificence of execution, has surpassed the Old World." After spending the winter in London, Audubon returned to the United States in April, 1829, and made his way, interrupted by excursions in quest of birds, to Little Egg Harbor, New Jersey, and the "Great Pine Swamp" in Northumberland County, Pennsylvania, to his home in Louisiana, which he reached in November. His book, in the mean time, was going steadily on, and the first volume was published in London in 1830. It

contained one hundred plates, representing ninety-nine species of birds, with every figure of the color and size of life. The whole work was completed in four volumes, in 1839. It contained four hundred and thirty-five plates, representing one thousand and sixty-five distinct specimens of birds—all, from the eagle to the humming-bird, of the size of life. Again, after three months at home, spent in hunting and drawing, he visited England in 1830, where he found that he had been elected a Fellow of the Royal Society of London, and on the 6th of May took his seat in the great hall, and paid his entrance-fee of fifty pounds, "though I felt myself that I had not the qualifications to entitle me to such an honor." He was shortly afterward joined by his wife, who accompanied him in his journeys to get new subscribers. In 1831, anticipating another tour of observation and study in the South, he visited Washington, to get letters of introduction to the commanders of frontier posts and officers along his route. All received him in the kindest manner. The winter of 1831–'32 was spent in East Florida, in what Audubon called a rather unprofitable expedition, but which furnished the material for several striking "episodes," as his accounts of the events have been designated.

In his subsequent journey Audubon visited the coast of Maine, accompanied by his family. According to Dr. Griswold's account,* although no reference to the circumstance is made in Mrs. Audubon's "Life," the cholera then prevailing in the country, he was taken sick in Boston and detained there for some time. Aside from his illness, his experience in Boston must have been of the most grateful character, for he wrote of it, "Although I have been happy in forming many valuable friendships in various parts of the world, all dearly cherished by me, the outpouring of kindness which I experienced in Boston far exceeded all that I have ever met with." With these kindnesses he associated the names of the men who lent to the Boston of that time its peculiar luster. Continuing his journey, he explored the forests of Maine and New Brunswick and the shores of the Bay of Fundy, and then went by schooner to the Gulf of St. Lawrence, the Magdalen Islands, and the coast of Labrador; and in the latter part of the season visited Newfoundland and Nova Scotia. In the ensuing spring, after nearly three years of travel and research, he went for the third time to England, where, and in Edinburgh, he lived a year and a half. As soon as the first volume of the "Birds" was published, Audubon began his "Ornithological Biographies," to accompany it; a work which, besides descriptions of the birds, contained reminiscences of personal adventure, with delineations of scenery and character. It was completed in five volumes (1831–'39). It has a literary and historical value apart from that which the accounts of the birds give it, in that it presents in language warm from his having been a part of the scenes, a virgin past of our country, and its forests

* "Prose Writers of America," p. 189.

and prairies, which can never be restored or so well described again. Having spent the winter of 1836–'37 at Charleston, with excursions to the sea-islands, Savannah, and Florida, Audubon, in the spring of 1837, sailed in a revenue-cutter for explorations in the Gulf of Mexico, of which he has left sketches of scenes in the Louisiana bayous, and in Texas. In 1838 he returned to Edinburgh, where he spent several months in preparing the fourth and fifth volumes of the "Ornithological Biography" and in finishing the drawings for the "Birds." In 1839 Audubon came back to the United States for the last time, bought an estate on the banks of the Hudson River, which he called Minniesland—now Audubon Park, and within the city of New York—and engaged in the preparation of an edition of the "Birds" in volumes of a reduced size. In this edition the matter was classified, a feature which had not been found practicable in the method of publication of the original edition. He had also had in hand for some time a book on the "Quadrupeds of America," for which he, his sons, Victor Gifford and John Woodhouse Audubon, and the Rev. John Bachman, of Charleston, South Carolina, had gathered much material. A trip to the Rocky Mountains had been planned in connection with this work, but Audubon was induced to give it up, after having gone as far as the Yellowstone River, on account of his age. The first volume of the "Quadrupeds," which was largely the work of his collaborators, was published in 1846, and the last volume in 1854, after Audubon's death. During the last four years of his life, Audubon became weak in mind, and not able to do any regular work. "The interval of about three years," says Mrs. Audubon, "which passed between the time of Audubon's return from the West and the period when his mind began to fail, was a short and sweet twilight to his adventurous career. His habits were simple. Rising almost with the sun, he proceeded to the woods to view his feathered favorites till the hour at which the family usually breakfasted, except when he had drawing to do, when he sat closely to his work. After breakfast he drew till noon, and then took a long walk. At nine in the evening he generally retired. . . . He was very fond of his grandchildren, and used often to take them on his knees and sing to them amusing French songs that he had learned in France when he was a boy. . . . After 1848 the naturalist's mind entirely failed him, and during the last years of his life his eye lost its brightness, and he had to be led to his daily walks by the hand of a servant."

Various estimates of Audubon's character and work, and accounts of his appearance have been given us, all to his praise. Dr. Griswold says, in his "Prose-Writers of America," that his highest claim to admiration "is founded upon his drawings in natural history, in which he has exhibited a perfection never before attempted. In all our climates—in the clear atmosphere, by the dashing waters, amid the grand old forests, with their peculiar and many-tinted foliage, by him first

made known to art—he has represented our feathered tribes, building their nests and fostering their young; poised on the tip of the spray and hovering over the sedgy margin of the lake; flying in the clouds in quest of prey, or from pursuit; in love, enraged, indeed, in all the varieties of their motion and repose, and modes of life so perfectly, that all other works of the kind are to his as stuffed skins to the living birds. But he has also indisputable claims to a respectable rank as a man of letters. Some of his written pictures of birds, so graceful, clearly defined, and brilliantly colored, are scarcely inferior to the productions of his pencil. . . . From the beginning he surrendered himself entirely to his favorite pursuit, and has been intent to learn everything from the prime teacher Nature. His style as well as his knowledge is a fruit of his experience." His personal appearance, as a reference to his portrait will show must have been the case, was calculated to impress a visitor. He is described as having been tall and commanding in person, with a countenance which, from the sharp glance of his eye and the outline of his features, "suggested a resemblance to the eagle." He is believed, from his own account, to have been somewhat of a dandy while he was living at Perkiomen. "It was one of my fancies," he says, "to be ridiculously fond of dress; to hunt in black satin breeches, wear pumps when shooting, and dress in the finest ruffled shirts I could obtain from France." When on his hunting-tours, as he records in the relation of a visit to Niagara, he would allow himself to get into the plight of the poorer class of Indians, and worse, from not having, like them, plucked his beard or trimmed his hair in any way. "Had Hogarth been living, and there, when I arrived, he could not have found a fitter subject for a Robinson Crusoe. My beard covered my neck in front, my hair fell much lower at my back; the leather dress which I wore had for months stood in need of repair; a large knife hung at my side; a rusty tin box, containing my drawings and colors, and wrapped up in a worn-out blanket that had served me for a bed, was buckled to my shoulders. To every one I must have seemed immersed in the depths of poverty, perhaps of despair." Some explanation was needed to convince the landlord of the hotel that he was a suitable subject for entertainment, but it seems to have been satisfactory. Christopher North says of him in the "Noctes Ambrosianæ," as he appeared at Edinburgh: "The man himself is just what you would expect from his productions; full of fine enthusiasm and intelligence, most interesting in his looks and manners, a perfect gentleman, and esteemed by all who know him for the simplicity and frankness of his nature."

CORRESPONDENCE.

MORE ABOUT MEN'S AND WOMEN'S BRAINS.

Editor Popular Science Monthly:

SIR: In replying to a letter by me, published in the June number of this journal, Dr. William A. Hammond dispensed with the ordinary courtesy of discussion, and, at the same time, quite dexterously evaded the question at issue. He drops the "numerous, striking, and easily-detected sex differences in brain" which were "to be perceived at once" in comparing the two, and devotes himself to the one element of weight, which, so far as I know, no one has questioned, *provided* the relative body-weight is not allowed for between the sexes as it *is* in the *tables where* men alone are compared.*

Dr. Hammond quotes from various writers on anthropology to prove points with which my questions had nothing whatever to do. Some of his quotations are from authors whose theories are discredited by later investigations; others are simply unsupported assertions; while his display of dialectic pyrotechnics and personal innuendo are both interesting and amusing even to me, their victim, but they are certainly not argument.

The doctor acknowledges that he can not accept the offer I made him—to distinguish the male from the female brains of twenty specimens marked in cipher—thus corroborating my position and that of the able and unprejudiced anatomists and physicians who assured me that there exist no sufficient data upon which to make the bold (and to use the doctor's own words) "rough-and-tumble" assertions which have been made by him as to the "radical and easily to be discovered characteristic sex differences in brains." To cover this, he makes a proposition to me, which is entirely aside from the question at issue, and in the face of the fact that I have never said that I could perform any of these wonderful feats.

I am quite willing to say that I can not. And since the science of anthropology is as yet in its infancy; since its various students disagree; and since within the past few months one of its cardinal principles has been found to be unsound, I am all the less willing to accept the sweeping statements of Dr. Hammond in regard to his being able to tell "at once the difference between a male and a female brain" by "numerous, easily-discovered, natural sex differences"; because of which differences he asserts both the incapacity of woman to learn and the danger of allowing her to attempt studies and occupations which he holds are unsuited to her lower brain organization.

It is just here that I join issue with him. And I maintain that no anatomist or physician has a right to assume these radical differences to exist, and, upon insufficient and conflicting data, make positive statements calculated to restrict woman in the use of whatever brain capacity she may have.

He finds woman's brain deficient in gray matter he says. Why deficient? Because man has more than she, and of course he is always assumed to be the highest type. But in this connection I find that Meynert says, "It" (the gray substance) "is more abundant in the brains of animals than in that of man, and indeed the proportion of gray substance *increases the more remote the brain-type is from the human.*" The italics are mine.

"A nervous impulse takes, according to Helmholtz, about twelve times as long to travel through the gray substance as it does to be transmitted through the peripheral nerves."—Ibid.

Is this a reason why women are said to think more rapidly than men, or to have "intuitions" which, Dr. Hammond graciously says, "stand her in good stead for thought"?

The doctor once more uses as illustration the "well-known fact" that these characteristic brain differences are greater between the sexes, and more to woman's discredit, the higher we go in the scale of civilization.* This he uses again as evidence that woman has not utilized the opportunities which she has never been allowed to have. But here comes—a few weeks ago—the news that the assumption upon which this is based is all wrong.

The Terra del Fuegans' brains have been used to illustrate the low organization of brain possessed by the lower races of man. It was assumed that the anatomical differences between their brains and ours

* See Le Bon, "Schwalbe Neurologie."

BODY-HEIGHT.	BRAIN-WEIGHT.
148–158 centimetres.	1,289 grammes.
158–168 "	1,328 "
168–178 "	1,373 "
178–189 "	1,387 "

* This does not agree with Huschke and Le Bon, even upon the old theory and estimates.

The German average brain-weight is given as superior to the French, the former being 1,416 grammes and the latter 1,333, yet the estimated difference between the sexes is 222 grammes, for the French, and only 180 for the Germans.

were so marked and so well known as to be quite beyond further dispute.

The latest test reveals the somewhat startling fact that these great *race* differences, even, are unproved assumptions, and the Terra del Fuegan brain is now said to possess proportions and characteristics that *in no way* enable anatomists to distinguish it from that of a Caucasian of the higher races. Here is a revelation, indeed, as to the state of anthropological knowledge! Now all this is frankly stated and acknowledged by the able brain anatomists who have no axe to grind, and are anxious to follow truth, even though it may confound their own theories.

This latest discovery in anthropology gives a pretty clear hint as to the accuracy of the information to be had, not only as to sex differences, but as to whether "these sex differences are greater the higher we go in civilization."

Since the foundation itself is knocked from under the theory, it looks as if the superstructure also may possibly need to undergo more or less repair at no distant day. This is what I contend for. Not because I pretend to be a brain anatomist, nor even a thorough student of anthropology. I have made no such claim; but I have said, and I now repeat, that those who *are* both of these (and whose standing as such I do not feel called upon to defend against Dr. Hammond's "fine and noble scorn," more especially since one of these very men was recently referred to by him as "the leading brain-anatomist in New York"), who are careful and honest brain students and anatomists, assure me that the present state of knowledge can not justify any one in making the sweeping statements made by Dr. Hammond as to the "numerous, striking, easily to be detected sex differences in brain."

The doctor invites me, in a tone of triumph (although I repeat this is not the question, and no amount of rhetorical dust can hide that fact), to find in all the records a woman's brain which weighs as much as Dr. Chalmers's (fifty-three ounces). Then he asserts that no woman's brain has ever been weighed in all the world which, if healthy, weighed over fifty-six ounces, while Cuvier's (whose brain, by-the-way, he does not mention, was not a healthy one, and that a part of its weight was due to that sad fact), and Abercrombie's weighed more than fifty-six ounces, and Webster's, Lord Campbell's, and Spurzheim's, came within two or three ounces of weighing as much.

Now, so far as I am able to learn from books and from the profession, the brain of no remarkable woman has ever yet been weighed, to pit against those of these remarkable men. The brain of a Sappho, a George Eliot, or an Elizabeth Cady Stanton, might possibly make as fair a show as those of these gentlemen; but, unfortunately, woman's brain is, at the present time, labeled to fit the tramps, hospital subjects, and unfortunates, whose brains have, so far, been weighed and analyzed, and *these* are what are held up as the fair representative of woman and her capabilities, as against the Cuviers, Websters, and Byrons.

I assure Dr. Hammond that I am quoting a gentleman of his profession, and a friend of his, when I say "this is wholly unjust and absurd. It is simply no test at all." But in this connection it is only fair to state that, taking both sexes in this class of brains—hospital and unfortunates—Weisbach found that in the frontal lobes, which Dr. Hammond says is the intellectual part of the brain,* the female brains were relatively larger than the males. The per cent being, males, 87·86, and females, 88·05;† while Meynert reports the cerebellum in this class of brains to be exactly alike in the sexes—41¼ per cent each.

It is a significant fact that Welker and the more recent Italian writers differ 100 grammes in their estimate of the weight of Dante's brain. If this enormous variation of estimate is possible in an individual brain, it seems not wholly impossible that there may be room for corrections in estimates made on sex differences where it is only claimed that these same 100 grammes exist as an estimated sex difference covering many cases, nations, and conditions, and containing brains of only the most ordinary women.

But the doctor says, "Now let Miss Gardener and the twenty leading brain anatomists, etc., search the records of anthropology and their own immense collections for the brain of a woman weighing as much as the least of these—Dr. Chalmers." There is in Dr. E. C. Spitzka's collection a female brain to meet even this unreasonable requirement, and she was not a remarkable woman either. Unimportant as she was to the world, she not only met Dr. Chalmers, but gave a point or two in the matter of weight to Lord Campbell, Daniel Webster, and Spurzheim. Her brain weighed 54 ounces. Now I trust that

* I give these authorities, fully recognizing that in this case it is against my point to do so. Munk says, "Intelligence is located everywhere in the cerebral cortex, and nowhere in particular." "I wish to add, in corroboration of this view," says Meynert, "that no author of the present day would be likely to insist on one special seat of memory, for memory is the common property of all cortical cells and fibers, which are able to receive and conduct external stimuli of all sorts." When Meynert said "No writer of the present day would be likely to insist," etc., he did not know Dr. Hammond.

† "Pfleger insists on the relatively greater development of the hemispheres in man as compared with those of woman, the exact relation being as 795 to 787 on the scale of 1,000. Engel has shown that this assigns the larger cerebellum to woman during the prime of life."—Meynert's "Psychiatry," p. 56.

Dr. Hammond will not fly to the conclusion that I suppose this woman to have been the superior, mentally, of those remarkable men. I do not myself lay so much stress upon mere brain-weight as the doctor does, but I simply meet his case as a matter of charity, and because it is easy to do so.

One other point, and I am done for the present. I shall shortly review the matter at greater length in a more readable form. The doctor says: "I stated . . . that the human head does not grow after the seventh year. . . . Instead of *head*" (the italics are the doctor's, although he says the use of them is a feminine characteristic and most objectionable), "I should have said *brain*, and then the point involved would have been more correctly stated." Perhaps it would have been, although that, also, is questioned by competent authority, but for the moment I have nothing to say as to that.

It is unfortunate, however, that a "scientist" should permit himself to resort to this sort of trickery in words. Perhaps it would have been more exact to say brain instead of head in that connection, but the doctor did not say brain, *and he did not mean* brain at that time, and until he was absolutely cornered on that point. How do I know? Allow me to quote the rest of the sentence in which it occurred, and which I omitted before, only because I, unlike the doctor, was limited as to space, and thought verbosity unnecessary, not dreaming that he would resort to such a trick. Here is his original sentence: "A fact which is somewhat astonishing to those not aware of it is, that the head of a boy or girl does not grow in size after the seventh year, *so that the hat that is worn at that age can be worn just as well at thirty.*" (I regret that I had to use italics here to call the doctor's attention to his own meaning, since he does not like italics. I do not myself; but there are times when they seem to be very necessary.)

Now, unless the doctor is in the habit of fitting his hats to his brains and not to his head, this last explanation is simply a bit of artful dodging, and surely unworthy of any one who is in search of simple truth.

HELEN H. GARDENER.

AN ANOMALY IN PLANT-GROWTH.

Editor Popular Science Monthly:

SIR: There was to be seen in Stockbridge, Massachusetts, in 1841, and for several years afterward, a vegetable phenomenon which puzzled the rural observers and the few professed naturalists of the county. Two beech staddles, some six inches in diameter, grew within a foot of each other. About eight feet from the ground a lateral branch of one of them, growing tightly athwart the trunk of the other, had become incased by that trunk, so as to present the appearance of being thrust through it. Some one had cut off the absorbing stock two or three feet above the surface-soil, so that it hung by that lateral branch, and might be easily swung to and fro, thus:

The severed stock continued to live and grow, not only *above* the supporting limb, but *between the limb and the severance below.*

It was manifest that the top of the sundered tree was supplied through the transverse branch in the ordinary method of upward growth; but not so apparent how the *lower* portion continued its existence. If by the same agency, then seemingly by a reversal of the laws of vegetable circulation. It would not have been strange that shoots should appear on the severed stock the second season after the separation, since sap sufficient to start them might be retained in its tissues, particularly if the excision were done during the winter, which may have been the fact—this I do not know; but that this life should continue in the *lower* portion for successive years, is the mystery of the matter. I saw it during the third or fourth season after the separation, and can testify to life therein, though not the vigor of a thrifty young tree. The supporting trunk had increased much more than its mutilated companion. This shrinkage of vitality might have resulted in ultimate death, had not further experiment been precluded by the thoughtless removal of both for fire-wood by an ignorant chopper.

Will some of your learned correspondents explain to us rural marvelers this growth from downward-moving sap, or, apparently, from no sap at all obtained directly from mother earth?

E. W. B. CANNING.

STOCKBRIDGE, MASS.

LITERARY SCIENCE.

Editor Popular Science Monthly:

SIR: In "The Popular Science Monthly" for February, 1887, you say: "Everybody, nearly, has been reading 'King Solomon's Mines,' but perhaps not very many have

noted the startling fact recorded in it. The gifted narrator tells us how, shortly after the sun had sunk in the west, there came a glow in the east, and presently 'the crescent moon peeps above the plain'"; then you tell Mr. H. R. Haggard that it "won't do." Now I wish to call your attention to the fact that there must be people who think it will do, because, in "The Book-Buyer" for April, 1887 (Charles Scribner's Sons), in a short review of "Cathedral Days," by Anna Bowman Dodd, Mr. Edmund C. Stedman quotes a descriptive passage. He says, "Take this sunset picture with its felicitous touch at the close." The "felicitous touch" contains the following: "The work of the day for man and beast, and for the sun, as well, was done: all three were going to their evening rest. A boy with a sickle over his straight young back walked near us, whistling a gay little air. The sickle was repeated in silver in the sky, the dawning crescent of the young moon cleaving the *eastern* horizon." I do not like Mr. Haggard's books; they are as sickening as raw meat. But he has been rated so soundly on that one mistake that I wish it noted that others, and educated people, too, can make the same blunder.

Yours respectfully,

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JAMAICA PLAIN, MASS.

EDITOR'S TABLE.

CULTURE AND CHARACTER.

THAT intellectual superiority is not an end in itself is apparent from more than one consideration. Comte has said with truth that "we get tired of knowing, but never get tired of loving"; and a writer who carries more authority still has said that, when tongues fail and knowledge ceases, charity will still abide. What seems to decide the question, however, is the fact that, when knowledge or intellectual power is made an end in itself, the result is more or less failure and disappointment. "Knowledge comes, but wisdom lingers," the poet has said; and, to a reflective mind, the distinction between the two is not difficult to seize. He who has knowledge only, knows things and their relations; himself and his relations, above all himself in his relation to the true human ideal, he does not know. He seeks to make his knowledge subservient to his own personal ends; he does not regard it as a revelation of duties to be done, of sacrifices to be made, of heights to be attained. He who has wisdom, on the other hand, holds his knowledge in trust for higher than personal ends, and makes us realize, as other men do not, the true value and dignity of knowledge.

Character, then, is the principal thing. It is character that we continually find to be limiting and conditioning culture; that is to say, if culture is not carried farther than we find it to be in certain cases, the reason is that the character, the moral nature, has not been such as to support and sustain a truly generous culture. There is, perhaps, a finely-developed æstheticism in certain directions, but the lack of culture's perfect work is seen in a certain hard materialism of personal aspiration. The disciple, perchance apostle, of beauty is far from beautiful when we get a glimpse of his inner life and essential aims. He has never learned that the prime secret of all beauty in human life lies in *disinterestedness*, in the ability to put self aside, on some occasions at least, and to live in causes and principles and, above all, in one's fellow-beings. Few things are more trying than the mock enthusiasm of very mediocre men and women for things that they have learned to admire as by rote, to hear the jargon of the literary or artistic coterie and to know how little it all means as regards real elevation of character and sentiment. And what we say of literary and artistic coteries we might apply with equal truth to scientific coteries, where minute points of classification and nomenclature are discussed with infinite zeal

and warmth, but with far less regard to any advantage to be reaped for the cause of truth and of humanity than to the satisfaction of rival vanities.

In this country we are laboring with great zeal and vast pecuniary resources to promote the cause of culture. We educate, educate, educate, as somebody once said we ought to do; but whether the result is to produce much that can be called culture in any high sense is an open question. A criterion may, perhaps, be found in a comparison of the rising with the now adult generation. Are our young people showing graces of mind and character in more abundant measure than their parents? Are their aims higher? Is their language better? Are their intellectual occupations more serious? Are their manners gentler and more refined? We do not propose to answer these questions dogmatically; but this we say, that, unless there has been an improvement in these several respects, a vast amount of educational effort has not met its full reward. Speaking broadly, it seems to us that the culture of our educated classes, or of the classes supposed to be educated, leaves much to be desired, and we are disposed to think that one reason of this is that we have conceived of education in too purely an intellectual sense. We have thought more of sharpening the thinking faculties than of liberalizing the sentiments or softening the manners. We have introduced too much of rivalry into education, and represented education too much as a preparation for further rivalry in after-life. We have imparted knowledge, but have only to a very moderate extent succeeded in inculcating wisdom; and knowledge without wisdom seems poor, thin, and sometimes even meaningless. We need, as it seems to us, to devote more consideration than we have hitherto done to the question, What is the true ideal of human life? If we can fix upon the true ideal, we can proceed to educate toward that, and our work will then be directed toward something that is an end in itself. The knowledge we impart will be held by a different tenure, and applied in a different spirit. What each one knows will be his or her equipment toward a worthier fulfillment of social duties, a worthier realization of what is best in himself or herself, and not a mere stock-in-trade for the procuring of personal gratifications. What we would chiefly insist upon at present, however, is that, were knowledge pursued in a right spirit, the intellectual gain would be very great. Minds would become more receptive, owing both to the superiority of the motive set before them, and the higher degree of rationality that the whole system of human life and thought would assume. Civilized speech would not show a constant tendency to degenerate into a jargon of slang, if people recognized in speech a social function, not merely a mode and means of self-assertion. It is impossible to find one's self in any fortuitous assemblage of average human beings without being led to reflect how much human intercourse might be improved and beautified if, by some means, we could implant in the mind of each individual a true respect for the rights and feelings of others, and a general sense of what is due to society, considered as the source of unnumbered advantages to all its members. At present it often seems to be a distinct aim with many persons—and these not in any sense social outlaws, but, on the contrary, what would be called "respectable people"—to show how little they care for anything beyond their own pleasure and convenience. The popular idea of "independence," indeed, is largely made up of swagger and aggressiveness; whereas the most primary notion of independence should embrace the making of an honest return for all good received. Thus viewed, the man who wished to be "independent" would see that society got back

from him in service something like a compensation for the benefits with which it surrounds him by day and by night. But "independence" in this sense is absolutely inconsistent with swagger or any form of unsocial action or sentiment. We can conceive of some philosophic mind saying to this great nation, "One thing thou lackest." Knowledge we have, and material power and business energy, and back of all this, no doubt, a great fund of true humanity. But the lack is in consciousness of the true aim of life, which is beauty and harmony in all social relations. The voice of Science itself bids us make a true generalization, a true synthesis, before we begin to work out our plans. We have hitherto stopped short too much at the idea of knowledge as an instrument of work and ambition, and have greatly hindered the growth of knowledge thereby. If we now set before us as our main object the building up of character in all its elements, we shall find our progress sure, if not rapid, and shall discover a deeper meaning and value in our labors from year to year and from age to age.

THE TYNDALL BANQUET.

THE dinner given to Professor Tyndall in London on the 29th of June, on the occasion of his retirement from his professorship in the Royal Institution, was also intended as a testimonial to the value of his work in the advancement of knowledge. The two hundred guests who participated constituted, according to the English papers, "as large and distinguished a company as ever assembled to do honor to a man of science"; or were "men who have rendered themselves notable in the pursuit and application of the most diverse forms of knowledge." It is questioned if English science has ever been more completely represented than at this banquet, where "the tables were crowded with men whose names are known wherever Nature is studied." Other men, equally eminent and equally representative in various fields, sent letters attesting their hearty concurrence in the honor intended for the investigator and teacher. British public life was represented by Lord Salisbury and other prominent men; literature, by Lord Lytton; and the United States, by Professor Asa Gray. Professor Stokes, President of the Royal Society, presided; and the presidents of several scientific societies were vice-chairmen.

Various reasons were given in the addresses why Professor Tyndall should be particularly honored. The chairman described his researches; Lord Lytton dwelt upon the value of his scientific writings as contributions to literature; Sir Lyon Playfair and the Earl of Derby spoke of the obligations the public service was under to science.

But Professor Tyndall's researches and discoveries were not considered his only claim to recognition. The feeling seemed general that the world was under peculiar obligations to him, of a higher character, because he had made science accessible to the public and attractive to the general reader. Professor Stokes insisted upon the importance, to the general diffusion of science, of expounding its leading principles and results, whether by lectures or by treatises, in which, while they are scientifically sound, popularity of style and general readableness are not sacrificed. Most of those present had had opportunities of being impressed with Professor Tyndall's lucid style and graphic expression in expounding to audiences the salient points of the scientific subject which he brought before them; and the same qualities were apparent in his books.

"Nature" also gives prominence to this feature of Professor Tyndall's work, saying that "if the wide-spread knowledge of science was to be, as it is, an

essential condition of national well-being, it was absolutely necessary that the people should know something of, and be in some sort of sympathy with, the methods and conditions of scientific thought. In supplying this need, Professor Tyndall's greatest work has been done. . . . He has, by his lectures and his books, brought the democracy into touch with scientific research. . . . He has done, perhaps, more than any other living man to compel those who regard knowledge as valuable only in so far as it is immediately useful, to admit that the seed which is sown in the laboratory often produces the most abundant harvest in the workshop." The "Times" thinks it not too much to say that the thirty-four years of Tyndall's occupancy of his professorship "have effected more than almost any other contemporary influence to diffuse a love of scientific knowledge among large classes of the community, and to prepare them for the acceptance of many ideas which, at least in their earliest forms, appeared to run counter to others which had been universally received."

We do not suppose that these thoughts are new in England; only that they have just now been given formal, authoritative expression. With reference to Professor Tyndall, they are familiar in the United States, where they were spoken fourteen years ago at a similar banquet given to him at the close of his lectures here; a banquet which was parallel in its significance and the diversified representative character of its company with the one in London. On this occasion, Professor Henry wrote that Professor Tyndall "is not only a distinguished laborer in the line of original research, but also one of the best living expounders of scientific principles. His books . . . have done more to give precise and definite knowledge of the principles of the sciences of which they treat than any other series of works ever published." Professor Safford, of the Dearborn Observatory, said he had shown us "how to employ extensive and deep researches in conveying a maximum of instruction to the world at large"; and Professor Jeffries Wyman desired to honor him "for his many contributions to physical science, and for his strict devotion to the exact methods of bringing scientific truths to light."

Among other features of the addresses at the London dinner deserving special notice are the Earl of Derby's admission that the gains we have derived from the applications of science —great as they are—are as nothing compared with those accruing from the acceptance of scientific habits of thought; and his significant assertion that British politicians have done the best they could for science—"they have let it alone; they have not corrupted it by their intrigues, nor vulgarized it by their squabbles; and they being what they are, and science being what it is, that is probably the best service they could have rendered it."

HONEST LIFE-INSURANCE.

Under the title of "Lawsuit or Legacy," we published, in the July "Monthly," an article reflecting somewhat sharply on the one-sidedness which still survives in many life-insurance contracts; and also alleging that it is not an uncommon practice for the companies, taking advantage of some qualifying technicality in their policies, to resist the payment of death-claims by menacing or openly attacking the character of the deceased. "Millions of dollars," says the writer of the article, "have been withheld from rightful heirs by threats of an exposure—the more vague, the more frightful—of unsuspected crimes and misdeeds of the beloved dead"; and, again, that "thousands of cases, never known to the public, have been compromised, and hundreds of heart-aches and unjust sus-

picions and fears about the dead which can never be corrected, are aroused in sorrowing but loving breasts by this method of doing business."

In commenting on the article, "The United States Review" takes exception to these statements, claiming that they are not only totally inconsistent with ordinary business self-interest, but contrary to the facts, and otherwise unjust to the companies. Having no concern in the matter beyond a desire that the public shall be accurately informed on the subject, we quote a part of what the "Review" says on this point, premising that, while it writes in the interest of the insurance companies, the tone of its article is both fair and reasonable: "It is only just to say that the companies now doing business in this country have paid over ninety-nine and one half per cent of the death-claims which have been presented without question, and they have paid a large proportion of the remainder without litigation. When it is remembered that certain cases of fraud arise which it is the duty of an honest management to unearth and expose, the proportion of claims resisted is small. All cases of compromise are brought within the limits of the foregoing statement. It is to-day a most unusual thing for a company to contest a claim. Indeed, we can point to an office founded twenty-two years ago which has never yet appeared as defendant in a suit to recover under one of its policies."

LITERARY NOTICES.

HISTORY OF THE PACIFIC STATES OF NORTH AMERICA. By HUBERT HOWE BANCROFT. Vol. I. Central America, 1501–1530. San Francisco: The History Company. Pp. 704. Price, $5.

THOUGH late in the order of actual publication of the series of histories, this volume is the first in the order of classification, and therefore rightly receives that number when regarded with reference to the series as a whole. The author's plan of logical arrangement is to begin at the south of the territory whose history he intends to record in the whole work, and advance toward the north; and this order corresponds in the main with the historical sequence. The volume is introduced by a general preface, giving a short summary of the plan of the whole series, and an elucidation of the theory on which it has been composed; matters which have already been discussed at length in our pages. The author avows the peculiarity of his method of work to consist in the employment of assistants, to bring together by indexes, references, and other devices, all existing testimony on each topic to be treated, whereby he obtains important information, which otherwise, with but one lifetime at his disposal, would have been beyond control. Acknowledgment is now made by name to five of these assistants. The amplitude in volume of the work is chargeable, the author says, "to the immense mass of information gathered rather than to any tendency to verbosity. There is scarcely a page but has been twice or thrice rewritten with a view to condensation; and instead of faithfully discharging this irksome duty, it would have been far easier and cheaper to have sent a hundred volumes through the press." The character and customs of the aboriginal inhabitants of the country at the time they were first seen by their subduers, and what can be gathered respecting their previous history, are discussed in the volumes on "The Native Races of the Pacific States," which are regarded as constituting a separate work from this. The "History" series, including the present volume on Central America, begins, therefore, with the Conquest, without reference to the matters treated of in those volumes. For the "History of Central America," besides the standard chroniclers and the many documents of late printed in Spain and elsewhere, the author has been able to secure a number of valuable manuscripts nowhere else existing, including some from the Maximilian, Ramirez, and other collections, with all of Mr. E. G. Squier's manuscripts relating to the subject. Much of the material has been drawn from obscure sources, from local and unknown Spanish works, and from the confused archives of Costa Rica, Honduras,

Nicaragua, Salvador, and Guatemala. The introductory chapter gives a general view of Spain and civilization at the beginning of the sixteenth century. The course of discovery is then followed up, with accounts of Columbus and his discoveries, the discovery of Darien, the further explorations of Columbus, the administration of the new colonies, the discovery of the Pacific Ocean, etc.; then the stages of further colonization and conquest, till the downfall of the Quiché nation, whose capital is described, and of the Cakchiquels and Zutugils, in 1524; and the volume closes with the account of the revolt of the Cakchiquels, in 1524–'25. The publishers inform us that an Eastern agency for Mr. Bancroft's works has been established, under the direction of Mr. F. M. Derby, at 149 Church Street, New York.

A HISTORY OF MODERN EUROPE. By C. A. FYFFE. Vol. II, from 1814 to 1848. New York: Henry Holt & Co. Pp. 513. Price, $2.50.

A COMPARISON of the condition and policies of the chief civilized nations as pictured in this book, with the present aspect of Europe, will help to give a realizing conception of the extent to which the world of politics and government has moved during the last forty years. We are slow to comprehend how fast we are making history till some survey of the recent past like this brings vividly before us what has happened in our own lifetime. The period whose events are recorded in the present volume of Mr. Fyffe's history, may be described, as in its earlier years, the period of reaction. It was the aim of its statesmen to restore Europe to the despotic *régime* which it endured before the French Revolution. Nationalities were cut up or combined, without a thought of how their people would be affected, to suit the ambitions and convenience of sovereigns and ministers whose chief aim was to crush out all life of freedom and enforce the asserted divine right of the few to govern and tax the many. The achievement of Grecian independence was a rude interruption to the successful pursuit of this policy; the French "July Revolution" of 1830 was a dangerous break in it; and the Revolutions of 1848 were the sign of its ultimate defeat, and of the ushering in of the present era when consideration of the desires and interests of the people is becoming more and more the accepted theory of the governments. The four leading features we have mentioned, in their order, constitute the framework on which Mr. Fyffe has wrought his history. The story is told with brevity and clearness.

PRINCIPLES OF EDUCATION PRACTICALLY APPLIED. By J. M. GREENWOOD. New York: D. Appleton & Co. Pp. 192. Price, $1.

THE author of this book is Superintendent of Schools of Kansas City, Missouri. His motive in preparing it has been to help teachers to do better and more intelligent work in the school-room. It assumes that education is a science; and that school-teachers can understand the principles of the science, and apply them accurately in their daily work to the children under their control. The object of the work throughout is to impress upon the mind of the teacher the question, "How shall I teach so as to have my pupils become self-reliant, independent, manly men and womanly women?" The foundation of the essay is laid in a chapter insisting on the application of the principles of psychology to the work of teaching; and this is to be made in the study of the temperaments of the children and the application of certain fixed educational principles in such a way as to secure an orderly and free development of the faculties. The succeeding chapters are of a more practical and concrete character, and show how the objects aimed at may be promoted in general school and class management, in methods of conducting recitations, in questioning, and in teaching the particular branches of reading, composition, and language, penmanship, geography, history, and arithmetic. Another chapter is devoted to "Health and Hygiene"; and studies of several typical boys are presented in the concluding chapter.

SOCIOLOGY. By JOHN BASCOM. New York: G. P. Putnam's Sons. Pp. 264. Price, $1.50.

THIS is not a treatise on sociology conveying a full and systematic discussion of the subject, but rather a bundle of essays on a number of topics of a sociological bearing. "It passes familiar principles, and principles to which the author can make no

important additions, and concentrates attention on points at which he is best able to reward it; and this with only secondary reference to general symmetry." Predominant interest is shared in questions of immediate moment to society. The author confesses to have covered a large field suggestively rather than a narrow field exhaustively; and he believes that that method is often "to be deliberately preferred in practical value, though it may involve a loss in personal estimation." In the introduction, the complexity of the facts of sociology is illustrated, and the relation of the social sciences to one another is considered. In the succeeding chapters are discussed the power of custom and its relation to law and public opinion; the development, operation, and function of government; the "three axioms" of political economy; the development of religion; ethics, its relation to customs and economics, and the connection of ethical law with government and religion; and various social problems, including the rights of women, prohibition, public education, equal civic advantages, franchises, laws of entail and inheritance, competition, the mission of the pulpit, and socialism.

HEALTH OF OUR CHILDREN. Pp. 128. Price, 75 cents. HEALTH IN OUR HOMES. Price, 75 cents. A HOUSEHOLD GUIDE IN HEALTH AND IN DISEASE. Pp. 460. Price, $3. Boston: Thayer Publishing Company. Cupples & Co., Wholesale Agents.

THE first two of these volumes have been compiled from a series of letters for popular reading, which were published in one of the newspapers of Boston. The first, a book of "practical advice to mothers," is based on the conviction that two thirds of the cases of illness among children arise from preventable causes, and aims to put before the reader, in the simplest manner possible, the important essentials in the care and management of children. The second treats of the faults tending to the production of disease which exist in many of our homes, and advises the application of those improvements and sanitary precautions by means of which a large part of the sickness now experienced may be avoided. The leading design of the "Household Guide" is to place before the reader those established principles, a knowledge of which is essential to the preservation of health, and to recovery when suffering from disease. Under the head of "Practical Hygiene" are considered the most common substances used for food, and their peculiar action; the laws of diet; personal hygiene, with the purpose of promoting correct physical habits. A chapter on mental hygiene treats of the intellectual operations and the relationship between the mind and the body. A third part relates to the sick-room and its general management, with chapters on nursing and the dietetic treatment of the sick. Under the heading of the "Principles of Medicine" are considered the symptoms and causes of disease, and medicines and their administration. The practice of medicine is taken up and described in its applications to diseases of the respiratory, circulatory, and digestive systems, the stomach and intestines, the abdominal organs, the nervous system, fevers, "general diseases," and "accidental disturbances."

ELEMENTS OF BOTANY. By EDSON S. BASTIN. Illustrated. Chicago: G. P. ENGELHARD & Co. Pp. 282. Price, $2.50.

THE author believes that there is need for some work on botany better adapted to the wants of our higher schools than any in present use; as well as of a work which is not so technical but that any student of fair intelligence may take it up without the aid of a teacher, and obtain a good foundation-knowledge of the facts and principles of the science. He has endeavored to supply such a book. He has aimed to make the text simple and free from unnecessary technicalities, and, in the order of arrangement of subjects, to lead the mind of the pupil from that which is familiar to what is less so. Hence those features in structure are first presented which may be understood without other aids than good eyes, nimble fingers, a pocket-knife, and a magnifier, before inviting attention to more delicate points. The organs are therefore treated of in the first part, as organs of vegetation and of reproduction. Vegetable histology is next presented, and is followed by the chapters on vegetable physiology and vegetable taxonomy. As subjects for study and description those plants are selected which are either familiar to most students, or which may be readily found and identified by means of the de-

scriptions given in the text. Illustrations are freely used, and the figures are all drawn with the author's own hand.

NATURAL LAW IN THE BUSINESS WORLD. By HENRY WOOD. Boston: Lee & Shepard. 1887. Pp. 211. Price, 75 cents.

IN its way, and so far as it goes, this is an excellent book. It is in no sense original, the truths it teaches being already familiar to students of economics. Indeed, the author makes no claim to originality, but characterizes his work as "an honest effort to trace out the working and application of natural law, as it runs through the economic and social fabric, in a plain and simple, though, it is hoped, practical manner." He speaks of himself as having had only a practical business training, though it is evident that he is familiar with the standard economic writers; and his literary style, if not so polished as some, is characterized by clearness and a certain epigrammatic point which makes some of his expressions very effective.

Mr. Wood is a thorough disbeliever in social nostrums and in all plans of reform that run counter to natural law. He says: "The ills of our social system, the hardships of labor, and the inequalities of fortune, can not be got rid of by any short-cut route of social revolution or industrial transformation. Circumstances and conditions may change, but principles never. Wealth has always been the natural sequence to industry, temperance, and perseverance, and it will always so continue." He calls attention to the fact, so obvious to all thinking men, but so often overlooked or ignored by agitators, that brain-labor is far more important to the world than hand-labor, and consequently that the assertion so often made, that all wealth is the product of manual labor, is not true.

Of course, the author condemns socialism in unsparing terms; but he evidently has no fear of its being practically adopted. He is also strongly opposed to labor-unions, and seems to think there is almost no good in them. He declares that "their entire action and effort are in the direction of vainly trying to combat the natural principle of supply and demand" (page 53). He also condemns them because they interfere with the free action of the individual laborer, are tyrannous toward non-unionists, and antagonistic to capital. In what he says on this subject there is much that is true, and would be profitable for labor agitators to read; but, like all who take a similar view of the matter, he seems to forget that the labor-unions themselves are a product of natural law just as truly as corporations are, and that they would not have grown up and lasted so long if there were not some solid foundation for them.

The author has done well to call attention once more to the reign of natural law in economic affairs; and if his work is not quite satisfactory, it is because he has too much overlooked the reign of moral law in the same field. We can not prosper economically unless we conform to economic laws; but neither can we unless we conform to moral laws, so far as these are involved in the production and distribution of wealth. On one point of business morality, indeed, the author speaks out in emphatic language in regard to the conduct of railway directors in speculating in the stock of their roads. His view is that "railroad managers control a valuable *trust*, and, if they profit by their superior knowledge, to the detriment of other stockholders, it is a moral wrong, which it seems proper to make a legal offense." If this principle had actually been applied in our industrial history, many of the colossal fortunes now existing in the country would never have been accumulated; and this shows the importance of moral law in the business world.

HENRY DRAPER MEMORIAL. First Annual Report of the Photographic Study of Stellar Spectra, conducted at the Harvard College Observatory. EDWARD C. PICKERING, Director. Cambridge: John Wilson & Son. Pp. 10, with Plates.

MRS. HENRY DRAPER, early in 1886, made a liberal provision for carrying on the photographic investigation of stellar spectra at the Harvard College Observatory, as a memorial to her husband, who did the first work of this kind in 1872, and continued it with great skill and ingenuity till his death, ten years later. The results of the year's work have been so encouraging, that Mrs. Draper has decided greatly to extend the original plan of work, and have it conducted on a scale suited to its importance. The

attempt will be made to include all portions of the subject, so that the final results shall form a complete discussion of the constitution and conditions of the stars, as revealed by their spectra, so far as present scientific methods permit. The investigations already undertaken include a catalogue of the spectra of all stars north of −24° of the sixth magnitude and brighter, a more extensive catalogue of spectra of stars brighter than the eighth magnitude, and a detailed study of the spectra of the bright stars. The report describes the instruments which are employed and the methods of observation, and gives accounts, illustrated by a plate, of the studies of five bright stars. The whole field of studies is intended to comprise catalogues and classification of the spectra of bright and faint stars, determinations of the wave-lengths of the lines, comparisons with terrestrial spectra, and an application of the results to the measurement of the approach and recession of the stars. Special photographic investigations will also be undertaken of the spectra of the banded stars, and of the ends of the spectra of the bright stars.

A MODERN ZOROASTRIAN. By SAMUEL LAING. London: F. V. White & Co. 1887. Pp. 265.

THIS book, like many others of late years, is evidence of two facts: first, that the traditional religion has lost its hold on most scientifically educated minds; and, second, that such minds are not content without some religion. In Mr. Laing's view all religions are "working hypotheses, by which successive ages and races of men try to satisfy the aspirations and harmonize the knowledge which in the course of evolution have come to be for the time their spiritual equipment." But when the "environment changes, when loftier views of morality prevail, when knowledge is increased, and the domain of science everywhere extends its frontier, religions must change with it if they are to remain good working, and not become unworkable and unbelievable hypotheses." That Christianity has become an unworkable hypothesis the author endeavors to show by the arguments that others have used for that purpose. He dwells particularly on such impossible doctrines as the Trinity, and also on the miracles which form so important an element in historical Christianity. He does not pronounce miracles impossible, but thinks that, as they are contrary to all we know of the course of Nature, they can not be believed without the most indubitable evidence of their occurrence, and such evidence is not forthcoming.

Moreover, Mr. Laing is troubled by the existence of evil, and hence he is unable to believe in the personality of the First Cause, since an omnipotent personal Creator must, in his opinion, be the cause of the evil as well as the good. His view of the First Cause is similar to Herbert Spencer's; but he thinks it necessary that our religious doctrine should frankly recognize the existence of evil as a fundamental constituent of the universe—proceeding, like good, from the unknowable First Cause. The antithesis of good and evil he seeks to identify with the principle of polarity in the material world, hoping thereby to bring it under a general law of the whole universe. He devotes several chapters to an account of this principle, beginning, of course, with the magnet, and then proceeding to the world of life and to those of morals and politics. He treats the antitheses of plant and animal, of male and female, and of heredity and variation, as examples of polarity, and regards the progressive and conservative tendencies in politics as another instance of the same principle. And, finally, the antithesis of good and evil is brought under the same category, so that in the author's view evil no less than good is an essential element in the universe. Such being the case, he says: "Now of all the religious hypotheses which remain workable in the present state of human knowledge, that seems to me the best which frankly recognizes the existence of this dual law, or law of polarity, as the fundamental condition of the universe, and, personifying the good principle under the name of Ormuzd, and the evil one under that of Ahriman, looks with earnest but silent and unspoken reverence on the great unknown beyond, which may, in some way incomprehensible to mortals, reconcile the two opposites, and give the final victory to good. . . . This, and this alone, seems to me to afford a working hypothesis which is based on

fact, can be brought into harmony with the existing environment, and embraces, in a wider synthesis, all that is good in other philosophies and religions."

Mr. Laing does not deny the excellent moral elements to be found in Christianity; but he thinks that there are also serious moral deficiencies in it, and that Zoroastrianism has "the most complete and comprehensive code of morals to be found in any system of religion." Moreover, he thinks that Christians at the present day are really worshipers of the good principle as personified in Christ; or, in other words, that "modern Christians are, to a great extent, without knowing it, worshipers of Ormuzd, with Christ for their Ormuzd"; and this he regards as an excellent thing, and perfectly in harmony with his own principles. Of course, Mr. Laing recognizes the fact that the Zoroastrian religion can not be adapted to modern needs without some changes; but he thinks it requires fewer changes than any other ancient religion, while it can at the same time absorb into itself all that is good in the others. We should add that the author's views are well expressed; the printer's part of the work has been well done; and readers having a taste for this class of subjects will find the book an interesting one.

THE STORY OF METLAKAHTLA. By HENRY S. WELLCOME. New York: Saxon & Co. Pp. 483. Price, $1.50.

THIS story is intended to excite sympathy. A tribe of savage Indians living in British Columbia, near the Alaska line, has been Christianized and civilized under the missionary efforts of the Rev. William Duncan, several thousand souls being comprehended under the influence of the work. An Anglican bishop has attempted to impose upon them a ritual and discipline which they reject, and the Colonial Government has taken land which they claim and given it to the Church Missionary Society. Their appeals for recompense having been refused, they are now seeking to remove in a body to Alaska, within the territory of the United States. The story of their claims and alleged wrongs is told in detail, with numerous references to official documents and public correspondence.

A HISTORY OF THE DOCTRINE OF COMETS. By ANDREW D. WHITE. New York: G. P. Putnam's Sons. Pp. 43. Price, 25 cents.

THIS is a fuller version of the author's essay, which was published, as the first of "New Chapters in the Warfare of Science," in the "Monthly" for October, 1885, and was read at the meeting of the American Historical Association in September of the same year. It is published in substantial form, on thick paper, and with clear, open type, as No. II, Vol. II, of the "Papers of the American Historical Association." With its copious citations from authors and notables of every age, and of the most curious theories and opinions on the subject, it is a paper of rare interest.

DINOCERATA: A MONOGRAPH OF AN EXTINCT ORDER OF GIGANTIC MAMMALIA. By OTHNIEL CHARLES MARSH. Washington: Government Printing-Office. Pp. 243, with Fifty-six Plates.

THIS memoir is the second in the author's series of monographs on the extinct vertebrate life of North America. The first volume described the *Odontornithes*, or birds with teeth, of the cretaceous deposits on the eastern slope of the Rocky Mountains. The present volume contains the record of a peculiar order of mammals, which Professor Marsh has brought to light in the early Tertiary strata of the great central plateau of the continent. Their remains have hitherto been found in a single Eocene lake-basin in Wyoming, and none are known from any other part of this country, or from the Old World. This lake-basin, now drained by the Green River, slowly filled up with sediment coming from the Wahsatch, Uintah, and Wind River Mountains, but remained a lake so long that the deposits formed in it, during Eocene time, reached a vertical thickness of more than a mile. It has since been subjected to a vast erosion, by which it has been carved into the picturesque Bad Lands; and this erosion has brought to light the remains of many extinct animals, among which the bones of the *Dinocerata*, from their great size, attracted particular attention. Among the other animals represented were ancestral forms of the modern horse and tapir, and of the pig. Many others were found related to the recent lemurs; also various

carnivores, insectivores, rodents, and small marsupials; remains of a new order of mammals, the *Tillodonts*, quite unlike any now living. Crocodiles, tortoises, lizards, and serpents swarmed in and about the waters of the lake, while around its borders grew palms and other tropical vegetation. The picture is finished with the conception of the *Dinocerata*, or terrible horned, gigantic beasts, which nearly equaled the elephant in size, and roamed in great numbers on the shores of the lake. They form a well-marked order in great groups of the *Ungulata*, or hoofed animals. In some of their characters they resemble the Artiodactyls (*Paraxonia*); in others they are like the Perissodactyls (*Mesaxonia*); and, in others still, they agree with the Proboscidians. The points of similarity, however, Professor Marsh adds, are in most cases general characters, which point back to an earlier, primitive ungulate, rather than indicate a near affinity with existing forms of these groups. The number of species is difficult to determine. About thirty forms, more or less distinct, are recognized in the synopsis at the end of the volume; but the number might be increased, if fragmentary specimens were used as the basis for specific names. The specimens which are now in the museum at Yale College represent more than two hundred individuals of *Dinocerata*. Of these, not less than seventy-five have portions of the skull more or less preserved, and in more than twenty it is in good condition. The author has endeavored in his plates, and nearly two hundred woodcuts in addition, to give accurate illustrations of type specimens; and all the important specimens now known are represented, and at least one figure is given of every species.

THE NEW CRISIS. By GEORGE W. BELL. Des Moines, Iowa: Moses Hull & Co. 1887. Pp. 350.

THE object of this book, as the preface declares, is "to prove the existence of a class conspiracy, the design of which is to subvert the principles of our Government by a monopoly of wealth." In other words, it is an anti-monopoly polemic, and has the usual characteristics of such works in a somewhat extreme form, but with little in it that is specially new.

INFANTS, THEIR CHRONOLOGICAL PROGRESS. By Professor STANFORD E. CHAILLÉ, M.D. Pp. 20.

BELIEVING that the inquiry is useful with reference to many points, Dr. Chaillé has collated in this pamphlet, as nearly in their order as may be, the various manifestations of infant life, activity, consciousness, and disposition, from birth up to the age of three years. This record is followed by notes on the color of the eyes and hair, and on growth as shown by height, weight, and chest-girth.

RESULTS OF THE OBSERVATIONS MADE AT THE BLUE HILL METEOROLOGICAL OBSERVATORY, MASSACHUSETTS, IN 1886. By A. LAWRENCE ROTCH. Pp. 45, with Plates.

THE Blue Hill Observatory is a private establishment, which is claimed to be one of the best-equipped meteorological stations in the United States. It is situated on Great Blue Hill, Norfolk County, Massachusetts, at an elevation of six hundred and thirty-five feet, making it the highest point within ten miles of the Atlantic coast from Maine to Florida. The present report gives a full account of the equipment of the observatory, and records of "general results," prevalence of winds, velocity of winds, and atmospheric pressure, for every day of the year, with annual summaries under each head, and several plates of tracings.

ELEMENTARY MICROSCOPICAL TECHNOLOGY. Part I. THE TECHNICAL HISTORY OF A SLIDE. By FRANK L. JAMES. St. Louis: Medical and Surgical Journal Company. Pp. 107. Price, 75 cents.

THE present number is a part of a work on general microscopic technology, the other parts of which will appear in time. It is intended to teach in detail the processes and manipulations for preparing the materials for a microscopic mount. For this purpose it takes the crude materials—the object to be mounted, the chemicals, gums, bits of glass, etc., entering into the structure of a slide—and carries them by minute descriptions through the processes of hardening (or softening), imbedding, section-cutting, staining, etc., up to the final mounting for the cabinet. It is purposed thus to give the student a general outline idea of the work, and a knowledge of the names,

uses, and functions of the instruments and materials used. Each stage and process is taken up in detail and in the order of occurrence in actual work; so that nothing is taken for granted, and no previous acquaintance of the student with the subject is supposed.

THE TREATMENT OF SEWAGE. By Dr. C. MEYMOTT TIDY. New York: D. Van Nostrand. Pp. 224. Price, 50 cents.

DR. TIDY'S researches on this subject are probably more widely known and more frequently quoted from than those of any other single author. He has made special studies through many years of the question of the disposal of the sewage of London. This manual gives the more important results of those studies, as they were presented by the author in a paper to the English Society of Arts.

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Harris, William T. How to teach Natural Science in the Public Schools. Syracuse, N. Y.: C. W. Bardeen. Pp. 40. 15 cents.

Kaine, J. L., Milwaukee, Wis. Conditions of Health in Cities. Pp. 18.

Marvin, J. B., M. D., Louisville, Ky. Renal Colic, Parasitic and Calculous, "A Criticism." Pp. 23.

Wachsmuth, Charles, and Springer, Frank. The Summit Plates in Blastoids, Crinoids, and Cystids, etc. Pp. 33, with Plates.

Lea, M. Carey, Philadelphia. Papers on the Photo-Chemistry of the Silver Haloids. Pp. 36.

Illinois State Board of Health. Report of Proceedings. July Meeting, 1887. Pp. 15.

Donaldson, Frank, Baltimore, Md. Heredity in Tuberculosis. Pp. 22.

Foster, Michael, and others. The "Journal of Physiology," June, 1887. Cambridge, England. Pp. 90, with Plates. $5 a volume.

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Withington, Charles F., M. D. Transmission of Infectious Disease through Rags. Pp. 69.

McCall, F., Twin Lakes, Minn. Thoughts on Theological and Scientific Theories. Pp. 36.

Stephenson, F. B., M. D., U. S. Navy. Duty of the State in Public Health. Pp. 11.

Robé, George H., M. D., Baltimore. Recent Advances in Public Medicine. Pp. 33.

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Iowa State Board of Health, Monthly Bulletin, July. Pp. 13.

Halsted, Byron D. Germination of Cucurbitaceous Plants. Pp. 6.

Massachusetts Agricultural Experiment Station. Feeding Experiments with Pigs. Pp. 16.

Mills, T. Wesley, Montreal. Retention and Loss of Hair from a Physiological Standpoint. Pp. 5.

Baker, L. W., Baldwinsville, Mass. Mental Epilepsy. Pp. 22.

Clark, Edward Gordon. The People's Right to Wealth, reduced to $s and Cents. "Monograph Publisher," New York. Pp. 14. 10 cents.

Cope, Edward D. Letters referring to the Completion of the Final Report of the United States Geological Survey of the Territories. Pp. 7.

Schlicht & Field Company, New York. "The Cosmopolitan," July, 1887. Monthly. Pp. 80. 20 cents a number, $2 a year.

Starling Medical College, Columbus, Ohio. Forty first Annual Announcement. Pp. 16.

Forbes, S. A., University of Illinois. The Lake as a Microcosm. Pp. 15.

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Shufeldt, R. W., M. D. Observations upon the Habits of Micropus Melanoleucus. Pp. 8, with Plates. On the Visceral Anatomy of Certain Auks. Pp. 5. A Critical Comparison of a Series of Skulls of the Wild and Domesticated Turkeys. Pp. 16.

James, Joseph F., Cincinnati. Account of a Well drilled for Oil or Gas at Oxford, Ohio. Pp. 9.

National Agricultural Exposition at Kansas City, Mo. September to November, 1887. Prospectus. Pp. 48.

Ingersoll, Robert G. Centennial Oration on the Declaration of Independence. Buffalo, N. Y.: H. L. Green. Pp. 22.

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United States Brewers' Association. Twenty-seventh Convention, Baltimore. May, 1887. Proceedings. Pp. 125. A Solution of the Temperance Problem proposed in Switzerland. Pp 15. The Effects of Beer. Pp. 46. Report, State Board of Health of New York, on the Examinations of Beers. Pp. 35. Colonial Liquor Laws. Pp. 202. Real and Imaginary Effects of Intemperance. Pp. 167. Alleged Adulterations of Malt Liquors. Pp. 80. Some Thoughts on the International Temperance Meeting held at Antwerp in September, 1885. Pp 40. The System of High Licenses. Pp. 86. Liquor Laws of the United States. Pp. 256, with Tables. All prepared by G. Thomann.

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State Board of Health, Wisconsin. Tenth Report. Madison, Wis. Pp. 250.

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Bancroft, Hubert Howe. History of the Pacific States of North America, Vol. XXXI. Popular Tribunals, Vol. I. San Francisco: The History Company. Pp. 749. $5.

POPULAR MISCELLANY.

Natural History Studies in Boston.—The reports of the Museum, as given in the "Proceedings" of the Boston Society of Natural History, indicate that considerable progress is being made in the cultivation of a public interest in the objects of the society. The purposes of the "Teachers' School of Science" were greatly aided by the liberal action of the trustee of the Lowell fund in defraying the expense of the lessons and in granting the use of Huntington Hall, and by the kindness of the volunteer agents in distributing and receiving applications and tickets. The superintendent of the public schools also aided the work, and took notice of it in his report. Fifteen lessons were given during the winter of 1883–'84, including five on the "Elements of Chemistry," by Professor Lewis M. Norton; five on "Vegetable Physiology," by Professor George L. Goodale; and five on "Chemical Principles illustrated by Common Minerals," by Professor W. O. Crosby; to all of which 2,798 tickets were given out, 2,295 of them to teachers. In the season of 1884–'85, ten lessons in zoölogy were given by the curator, mainly on a range of subjects specially indicated by the courses of instruction of the schools of Boston, for which 837 tickets were distributed. These were succeeded by a course of ten laboratory lessons in "Elementary Mineralogy," by Professor W. O. Crosby, which were attended by seventy-five persons, occupying the full capacity of the room. The Annisquam Laboratory has proved more useful, and its instruction has been more highly appreciated, than had been anticipated, and "a very decided revival in the number and quality of the attendance" is mentioned. Reliance is placed on the study of natural science in the public schools and in the Massachusetts Institute of Technology for assistance in keeping up the interest in this enterprise. In arranging the plan of the school, the director assumed that all persons admitted would be capable of conducting their own work, whereas they very rarely proved to be so; and that all the students would be able to realize that being taught how to do one's own work was more valuable than the mere information gained. As a rule, the ablest students acknowledged the benefit of the mode of work, and, after a short experience, expressed great satisfaction and gratitude.

Aztec Ikonographic Writing.—Ikonomatic is a term which Dr. Brinton applies, in distinction from ikonographic and alphabetic, to a kind of rebus-writing, in which a figure or picture refers to the name of an object, the sound of which is applied to the name of some other object or idea. It is exemplified in certain of the hieroglyphic inscriptions of Egypt, and in some of the heraldic devices of the middle ages. It was freely used in the ancient Mexican inscriptions, in which the suggestion of the figure itself, the relative position of the objects, and the colors used, all may have had, and evidently often did have, phonetic significance. The Aztec writing also contained determinatives, such in principle as are frequent in the Egyptian inscriptions, and numerous ideograms. Sometimes the ideogram was associated with the phonetic symbol, and acted as a sort of determinative to it. Besides employing it in proper names, the Aztecs composed in the ikono-

matic system words, sentences, and treatises on various subjects. In proportion as it was applied to connected and lengthy compositions, its processes became more recondite, curious, and difficult of interpretation —impossible without considerable knowledge of the spoken language The study of it has, however, been pursued with what Dr. Brinton calls marked and gratifying results, by Mrs. Zelie Nuttall Pinart. This lady, the author says, "has unraveled a number of the pages of the 'Vienna Codex,' and several of the monolithic inscriptions which have been handed down from ancient Mexico. With commendable caution she has refrained from publishing her results until they could be presented supported by such proofs that they can not be questioned; but from a personal examination of them I do not hesitate to say that they will be found to come up to the highest standard of scientific requirements."

An Incident in School Discipline.—An instructive incident in the administration of school discipline is related by T. C. Karns, in the "Southwestern Journal of Education." The subject was a boy naturally of good impulses, but who had conceived the idea of the existence of antagonism between teacher and pupil. It was agreed that he must be whipped for a serious breach of the order of the school which he had committed. He assuming a defiant attitude toward the teacher, the latter replied to him: "No; if you do not comply willingly, I will not whip you, Sam. There will be no contest between us; but, as you will not be subject to the rules which you agreed to obey when you entered school, you can not stay here longer, and I will write a note explaining all to your mother, which you will please to carry to her." This having been said pleasantly, the teacher sat down to write the note, while the boy waited and reflected. The note made a pleasant mention of Sam's good traits, and expressed regret that his failure to comply with some of the regulations of the school made it necessary to dismiss him. The boy was given it, but hesitated to start away, and said, "I am not going to take this to my mother." The teacher answered that if Sam did not want to take the note, he would send it by a carrier, or drop it in the mail, "But I thought you would prefer to carry it in person, and have something to say in your own behalf." Sam made another effort to start, but appeared to be overcome, and, walking up to the teacher, extended his hand, and said, "Whip me—I can't stand this!" The teacher, of course, would not whip him then, nor would he send the note to the boy's mother, but saying that all that had passed should rest between the two, added, "Only be sure that your conduct is all right for the future." "New light," says the teacher, "seemed to dawn upon Sam. This was a new experience for him. I nodded assent, and he passed out again. It was but a moment, when a head was again protruded at the door, and a choking voice uttered the words, 'Much obliged to you.' I never had any more trouble with Sam." The boy was conquered by just and manly treatment. When the spirit of antagonism had been removed, he had nothing left to stand upon, and his self-respect forced him to be a man in return.

Ptomaines in Stale Milk.—The evidence of the development of ptomaines in stale milk accumulates, and it is becoming more and more probable that the instances of poison-sickness which occasionally occur after partaking certain creams, or ices, or cheeses, may be traced to this source. Dr. R. H. Firth reports, upon the examination of some milk to which his attention was called as having occasioned sickness, that after the evaporation of an ethereal extract from the filtrate, a moist, semi-crystallized residue was left. It had a "mawkish, sickly odor," and a strongly pungent taste when put on the tongue. Taking some of it carefully himself, he was soon afterward conscious of nausea and dryness of the fauces, and then of headache. He gave all the remaining residue to a dog. The dog was within fifteen minutes purging, vomiting, and obviously ill. It gradually recovered, but, being afterward killed, its stomach and intestines were found to contain a serous and frothy fluid, but quite free of congestion or inflammatory action. Fresh milk when tested did not yield any substance having a toxic action. But of stoppered bottles of milk

set away for "cultivation," at a temperature of 80° Fahr., those opened after about ten weeks, yielded a white acicular crystalline substance having the same odor and taste as that found in the original suspected milk. The effects of this substance on the experimenter and on dogs and cats were the same. For this ptomaine, the author suggests the name of lactotoxine.

Myths and Theories about Earthquakes.—Professor Milne, in a lecture before the Scientific Society of Tokio, Japan, classified the theories that have been enunciated respecting the cause of earthquakes as unscientific, *quasi*-scientific, and scientific. Having mentioned as among the unscientific theories those which ascribed the convulsions to dispensations of Providence, the lecturer described some of the myths which attribute them to a creature living underground. In Japan it is an "earthquake-insect," covered with scales and having eight legs, or a great fish having a rock on his head which helped to keep him quiet. In Mongolia the animal was said to be a frog, in India the world-bearing elephant, in Celebes a world-supporting hog, in North America a tortoise. In Siberia there was a myth connected with the great bones fo nd there, that these were the remains of animals that lived underground, the trampling of which made the ground shake. In Kamchatka the legend was connected with a god that went out hunting with his dogs; when the latter stopped to scratch themselves, their movements produced earthquakes. In Scandinavian mythology, Loki, having killed his brother Baldwin, was bound to a rock, face upward, so that the poison of a serpent should drop on his face. Loki's wife, however, intercepted the poison in a vessel, and it was only when she had to go away to empty the dish that a few drops reached him and caused him to writhe and shake the earth. The *quasi*-scientific theories endeavored to account for earthquakes as part of the ordinary operations of Nature, as that they were produced by the action of wind confined inside of the earth. The theory of electrical discharges was advocated in 1760 by Dr. Stukely, and by Percival and Priestley, and is held in California at the present day, where it is believed that the network of rails is a protection to the State against dangerous accumulations of electricity. The lecturer thought that the electric phenomena which sometimes attended earthquakes were their consequences, not their causes. The chemical theories were very strong in Europe up to the beginning of the present century. It was only in 1760 that Dr. Mitchell first threw out the theory that earthquakes were connected in some way with volcanoes, and attributed them to the penetration of strata by steam. Professor Rogers, at about the same time, in America, endeavored to show that it was not steam, but really lava, that ran along underneath the ground, causing it to rise and fall, thus producing an earthquake.

Weathercocks.—Why, asks Mr. J. A. Farrer, in an essay on "Animal Lore," should cocks figure on the tops of steeples? Christians connect the custom with the reproach the cock once conveyed to St. Peter. But the cock used to be placed on the tops of sacred trees long before it was transferred to church-steeples, and in North Germany it still stands upon the May-poles. It was partly a watchman and partly a weather-prophet, and by its crowing it could disperse evil spirits and all approaching calamities. Its life was sacred in India and Persia, and Cicero speaks of the ancients regarding the killing of a cock as a crime equal in blackness to the suffocation of a father. Our weathercocks are doubtless the survivals of these old ideas, though the solar mythologists trace all these things to the use of the domestic fowls as obvious personifications of the sun. One can scarcely conceive anything more absurd; and it would be interesting to know how on solar principles would be explained the Tyrolese custom of not letting a black hen live for seven years, lest she should then lay an egg, out of which might issue a dragon destined to live a hundred years.

School-room Lights.—Dr. Willoughby, of the English Society of Medical Officers of Health, in a paper on "School Lighting," maintains that as long as the light from the left is the stronger, so that the shadow of the hand does not fall on the writing, the objections urged against "cross-lighting"

are imaginary; and that while the main source of light should always be on the left, it might be advantageously supplemented by lights of lesser intensity from either side, whereby the total illumination would be increased. In wide rooms the rows of desks on either side should face in opposite directions, so that the nearer and consequently stronger light should always come from the left. No natural light not coming direct from the sky could be sufficient, but whether sky-light were so or not would depend on the angle of aperture, or arc of the sky visible at any given point, which should never be less than 5°, and the angle of incidence, which should not be less than 25°. In artificial lighting, shades acting also as reflectors are preferable to semi-opaque globes, which involve much loss of light. The two points to be observed in the arrangement of the lighting are the avoidance of shadows and of the direct incidence of the light on the eyes.

Uses of Birch-Bark.—Professor Gustav Retzius has a chapter, in his sketches of Finland, respecting the uses which the Finnish people make of birch-bark. Shoes are made of it. The bark, having been peeled, is cut into strips, rolled up carefully, and put away for future use. When the Finnish peasant wants a pair of new shoes, he takes one of his rolls, cuts it up into strips of suitable width, soaks it in water to soften it, and then weaves it into the form he desires. It is all done very rapidly, a half-hour or less sometimes sufficing for the whole work. The shape of the shoes varies according to the use they are to be put to. If they are for swamps, he makes them into low-cut slippers or sandals. With these he can walk through the moors without wounding his feet on the sharp sticks, while the water flows in and out freely. Another shape is that of regular shoes with high sides, and toes either run out to a point or cut short off. They are made wider than is necessary to accommodate the foot, so that in cold weather they may be stuffed with hay and the foot wrapped with bandages. A third form is a kind of half-boot. All the three forms are still used in much of the interior of the country during work in the fields, the swamps, the woods, and the house, especially among the poorer people. These bark shoes have in fact many advantages. They are very cheap, costing really nothing; they are strong and durable, and warm, with the help of hay and wrappings. In moist ground they let the water in and out without softening, and, by changing the hay or wrappings, are easily dried. Many other uses are found for birch-bark. The sheath in which the peasant carries his inseparable knife is made of it. It is woven into pockets or bags of various sizes, which are used all over Finland. The larger of these form a satchel with a flap which may be turned over and close the bag. Wherever one may travel in Finland, he will meet children, women, and men with these satchels. The peasant carries his dinner in one, and with the satchel on his back, birch-bark shoes on his feet, and his tools in his hands, goes out equipped for his day's work. These satchels also take the place of baskets. Birch-bark is made into salt-tubs, cords and lines, brushes for washing out wooden vessels, boxes, sieves and tubs, and many other articles for which we use wood or basket material.

The Microscope in Geology.—President T. G. Bonney, of the Geological Section of the British Association, spoke on the "Application of Microscopic Analysis to discovering the Physical Geography of bygone Ages." The microscope furnishes us with an instrument of precision, by means of which we can learn the more minute mineral composition and structural peculiarities of rocks, can recognize fragments, and sometimes even determine the source of the smaller constituents in a composite elastic rock. Thus, by its aid, we may be able, in many cases, to substitute a demonstration for a conjecture. The speaker described the materials of the coarser fragmental rocks of Great Britain, and laid down the following principles of interpretation: 1. Pebbles indicate the action either of waves of the sea, or of strong currents, marine or fluviatile. 2. The zone in the sea over which the manufacture of pebbles can be carried on is seldom wider than from the high-tide line to a depth of within twenty feet below low-water mark. It is, therefore, probable that a thick and very widely-

extended pebble-bed is not the result of wave-action. 3. The movement of the deep waters of the sea, as a rule, is so slight that only the very finest sediment can be affected by it. The instances where great currents may transport pebbles and sand are exceptional, and confined to rather shallower water. The larger coast currents may, however, transport mud to considerable distances, but in directions parallel with the main trend of the shores. 4. Except where very large rivers discharge their water into the ocean, or in some special cases of 3, sediment is deposited comparatively near the shores of continents, according to the Challenger's sounding in no important amounts farther away than one hundred and fifty miles. 5. Thus rain and rivers are generally more important agents of denudation and transportation than the sea. 6. The coarser materials of rocks are capable of being transported by streams to a considerable distance without serious diminution of volume. 7. Deposits of gravel and coarse sand, of considerable vertical thickness and great vertical extension, are more likely to indicate the immediate action of a river than of a marine current.

The Happiness of Animals.—It is hard to conceive that the question, "Are animals happy?" should be seriously asked by any one who is acquainted with animals, or comprehends what constitutes happiness. Yet there are some writers—for scientific journals, too—who treat the question as open to debate, or are even inclined to answer it in the negative. Mr. Briggs Carlill, who thinks it worth while to take it up in the "Nineteenth Century," has no difficulty in giving a decidedly affirmative answer. Two general considerations, he says, precede all arguments on the subject, and may be disposed of in the beginning. They are, that animals do not commit suicide, though they might, and know how to do it; and that they increase and multiply—which they would not do were their condition miserable. Animals are, it is true, deprived of man's mental pleasures, which are the highest ones to those who appreciate them; but then they are, in partial compensation, spared from worry. With man, the local pleasures, or those of sensation and convenience, largely preponderate over mental pleasures, while of his pains, mental troubles constitute much the largest part. Suppose the mental powers gradually to diminish, while the bodily powers remain unimpaired till the mind no longer troubles itself about unseen things; we shall then approach the constitution of the higher mammalia. All animals enjoy the taking in of food. More highly developed ones have another opening for pleasure in the faculty of discovering sources of food; animals which catch their prey, the additional excitement of pursuit and capture; ruminants enjoy the chewing of the cud. Exercise counts for a good deal in the youth of all animals, and continues throughout life in the majority to afford enjoyment of the keenest description, while many of them have the delight that the power of swift motion gives. "Constantly throughout the animal world we notice that delight in the use of muscle and limb which in man scarcely survives his majority, but which in them lasts far into maturity. We are accustomed unconsciously to recognize their prerogative in this respect when we apply the phrase 'animal spirits' to a boy who is full of life and energy, and who enjoys a run over the hills on a breezy day." All animals, also, enjoy to a full extent the pleasures connected with the perpetuation of their species and the care of their young—the latter of which are akin to some of man's mental pleasures. What is there to set off against these pleasures which accompany alike the activities preservative of individual life and those preservative of the species? Principally, these four things — famine, exposure to weather, bodily injury, and violent death; things not altogether unknown to man. But the suffering in all these cases is of short duration, and is usually tempered by circumstances in the animal's age, condition, or power of adaptation, while the keenest element of it—the thinking about it—is wholly absent; so that its intensity is so much less in animals than in man that, even if the individual instances of it are more frequent, the balance of advantage would probably remain with the brutes. The author's conclusion, therefore, is, that "so far as bodily pains and pleasures are concerned, if in humanity there be a surplus of pleasure

over pain, there is in brutes a still greater surplus; if in humanity there be anything like an equality between pleasure and pain, there is in brutes a large preponderance of pleasure; if in humanity pain predominate, then in brutes the proportion should be reversed."

Air in Dwellings and School-Rooms.—In the experiments of Professor Carnelly on the air of dwellings and schools, and its relations to disease, a distinct increase of impurities was detected in the air of the close parts, as compared with the open spaces, of such towns as Perth and Dundee. As between different classes of dwelling-houses, one-, two-, and four-roomed dwellings, the average length of life in the one-roomed house was only twenty years, while in the better-class houses it was forty years. Hence, persons born and living in a one-roomed house have a chance of living only half as long as those born and living in a four-roomed house. This depends naturally to a considerable extent on other causes than impure air-supply. The best results in the relation of atmospheric purity to cubic space were noticed when the allowance was one thousand cubic feet for each person. The result, owing to stagnation, was not so good in larger rooms. Of sixty-eight school rooms in Dundee, twenty-six were mechanically ventilated, and the others were ventilated by means of windows. The advantage was found to be decidedly on the side of mechanical ventilation, which not only materially improves the quality of the air, but also causes less reduction in its temperature. The air was less pure in boys' schools than in girls' schools. Cleanliness of person had a comparatively small influence on the number of micro-organisms, but cleanliness of dwelling-rooms and schools had a most important effect. Hence, the air of new school-rooms is distinctly better than that of older buildings. The author suggests that the evil said to be due to overpressure in schools is, in many cases, due to imperfect ventilation.

How Lampreys build their Nests.—In a paper on "Lampreys of Cayuga Lake," read at the American Association, Messrs. S. H. Gage and S. E. Meek held that the study of the specific characters of these animals had convinced them of the specific identity of the sea and Cayuga Lake lamprey, and that the alleged specific differences are but seasonal and individual variations. In the spring, May and June, the lampreys ascend the largest of the streams flowing into the lake for the purpose of spawning. They build nests of stones in the bottom of the stream, usually just above declivities where the water breaks in ripples. In forming the nests the stones are removed, forming a circular or oval place, the diameter of which is a little more than the length of the lamprey. In removing the stone the lamprey fastens its suctorial mouth to the stones, wriggling strongly until the stone is loose. It then raises it free and floats down with the current to the lower edge of the nest, where the stone is dropped. In this way all of the stones are removed for a depth of from ten to twenty centimetres. As nearly all of the stones are piled up at the lower edge of the nest, that is the highest. The current carries down into the nest fine gravel, partly filling it. When the eggs are laid, the sand is stirred up, and the eggs being heavier than water sink with the sand and are covered by it. Lampreys if placed in an aquarium with other fishes will attach themselves to them and produce wounds.

Value of M. Pasteur's Hydrophobia Inoculations.—A committee appointed by the British Local Government Board to inquire into M. Pasteur's method of treatment of hydrophobia made a report in June, 1887. The committee consisted of Messrs. James Paget, T. Lauder Brunton, George Fleming, Joseph Lister, Richard Quain, Sir Henry Roscoe, and J. Burdon-Sanderson — men whose judgments in the premises can be relied upon if those of any men can. The committee visited Paris; made special examinations of ninety of M. Pasteur's earliest cases who were within easy reach of the capital; and through its secretary, Mr. Victor Horsley, made careful experiments on the effects of M. Pasteur's inoculations on the lower animals. The conclusion of the committee is expressed, after relating its observations, in the words: "From the evidence of all these facts, we think it certain that the inoculations practiced by M. Pasteur on persons bitten by rabid animals have prevented the occurrence of hydrophobia in

a large number of those who, if they had not been so inoculated, would have died of that disease. And we believe that the value of this discovery will be found much greater than can be estimated by its present utility, for it shows that it may become possible to avert by inoculation, even after infection, other diseases than hydrophobia. . . . His researches have also added very largely to the knowledge of the pathology of hydrophobia, and have supplied what is of the highest practical value, namely, a sure means of determining whether an animal, which has died under suspicion of rabies, was really affected with that disease or not." The answer to the question whether M. Pasteur's treatment can be submitted to without danger to health or life, must be qualified accordingly as the question is applied to the ordinary method, concerning the entire safety of which no reason of doubt has yet appeared; or to the intensive method which has been applied only to cases deemed especially urgent. In many of the urgent cases the intensive method is believed to have been more efficacious than the ordinary method would have been. In other cases deaths have occurred under conditions which have suggested that they were due to the inoculations rather than to the infection from the rabid animal. But in these cases it is open to doubt whether the effect of the inoculation may not have been to modify the form of the rabies already nascent, into "paralytic rabies," rather than of itself to produce it. In order to reduce risks, M. Pasteur has greatly modified his intensive treatment, and limited its application to the most urgent cases.

NOTES.

THE steamers of the new American "Arrow Line" are to be constructed upon a new principle, and with a view to an estimated speed sufficient to make the voyage between New York and Liverpool in a little more than four days. The Pocahontas will be 540 feet long, will be provided with 1,060 water-tight compartments, 500 of which are to be below the water-line, and will have 20 boilers with engines of 27,986 horse-power and capable of giving a speed of 22 knots an hour.

PROFESSOR ASAPH HALL has determined the parallax of Aldebaran at 0·102″, with a probable error of 0·0296.

THE sixtieth meeting of the German Association of Naturalists will be held at Wiesbaden, September 18th to 24th. A number of new scientific instruments and preparations will be shown.

AN unusually large number of foreign men of science will, it is expected, be present at the forthcoming meeting of the British Association in Manchester. Among the Americans are Cleveland Abbe, J. R. Eastman, of the United States Naval Observatory; and William Libbey, Malcolm McNeill, and C. A. Young, of Princeton College, in Section A; F. W. Clarke, J. W. Langley, and J. W. Mallet, in Section B; Asa Gray, C. S. Minot, and E. S. Morse, in Section D; Dana Horton and Judge Mackay, in Section F; and Thomas Egleston and J. B. Francis, in Section G.

DR. E. A. A. GRANGE, of the Agricultural College of Michigan, describes a disease in the foot of the horse, frequently occurring in the summer season, which he calls *laminitis*, but which is often manifested as what is called chest-founder, from the position which it causes the horse to take, suggesting an affection of the chest. The disease is really an inflammation of the sensitive laminæ of the foot, sometimes involving neighboring structures, and may be compared with toothache. It may be caused by overheating and sudden cooling, overworking, overfeeding, or too long and close confinement in the stall. It is manifested by attitudes indicating pain, by irregularities in breathing, twitching movements, etc. The treatment materially depends upon the cause in the particular case, and is both general and local.

THE British Inspectors of Explosives report for 1886 the continued satisfactory operation of the Explosives Act of 1875. Only one loss of life was returned in legitimate manufacture, as against an average of over eight in the eight years previous. Mention is made in the report of 143 accidents having occurred during the year, whereby 40 persons were killed and 136 injured. The averages for the previous nine years were 38 killed and 98 injured.

MR. ALFRED CARPENTER, of the Marine Survey office, Bombay, has observed Macacus monkeys on the island off South Burmah opening oysters with a stone. They bring the stones from high-water mark down to low-water, selecting such stones as they can easily grasp. They effect the opening by striking the base of the upper valve until it dislocates and breaks up. They then extract the oyster with the finger and thumb, occasionally putting the mouth straight to the broken shell. The way they have chosen is the easiest way to open the shell.

The "Technology Quarterly" has been started at the Massachusetts Institute of Technology. It is published by a board of editors chosen from the senior and junior classes, who are intended to represent all the departments of the Institute.

Dr. T. Langdon Down, inquiring into the causes of idiocy, has found that intemperance of parents is one of the most considerable factors in producing the affection. His view is confirmed by some French and German investigators, one of whom, Dr. Delasiauve, has said that in the village of Carême, whose riches were in its vineyards, ten years' comparative sobriety, enforced by vine-disease, had a sensible effect in diminishing the cases of idiocy. Nervous constitution and consumption exercise important influence. Of the professions, lawyers furnish the smallest proportion of idiots, while they are credited with the procreation of a relatively very large number of men of eminence. With the clergy, these proportions are more than reversed. The influence of consanguineous marriage, *per se*, is insignificant, if it exists.

The French Association for the Advancement of Science will meet in Toulouse, September 22d to 29th.

Bottles for holding spirits and acids are now made of paper. The glued paper is rolled by machinery into such a tube as is required, and the tube is cut up into suitable lengths. The tops and bottoms, of wood or paper, are cemented in, and necks are added when required. The interiors of the bottles are then lined with a heated fluid composition that sets hard and will resist acids and spirits. The bottles are practically unbreakable, have a minimum of weight, and require no packing material in transit. The manufacture is said to be carried on extensively in Chicago, and has been introduced into England.

Mr. Nordenskiöld some time ago received an account from Don Carlos Stolp, of San Fernando, Chili, of his observations of the "red sunsets" of 1883–'84, from a point on the Andes about fifteen thousand feet above the sea; and afterward Señor Stolp sent some specimens of an atmospheric dust which he had observed at the same time. Analysis of this dust showed that it had no relation to volcanic dust, but that it was of the kind regarded as cosmic dust—containing the iron, nickel, phosphoric acid, and magnesia constituents characteristic of the cosmic deposits. There is, however, no evidence that this dust was connected with the red light.

Mr. Ernest Hart, of the Smoke Abatement Institute, fears that London will always suffer from fogs, because it is placed in a river valley, on a clay soil, and is bordered on the Essex side by low-lying lands very imperfectly drained, and on the north side by the Harrow Weald. The fogs generated—the results of damp exhalations—are greatly aggravated by the parks, most of which require draining. But if the smoke is got rid of, the fogs will be much less dense.

An English National Association for the Promotion of Technical Education has been formed. The Marquis of Hartington is its president, and several lords, Professor Huxley, Sir John Lubbock, Mr. Mundella, Sir Lyon Playfair, Professor Stuart, and Professor Tyndall, are among its vice-presidents.

Photographs of the sun were taken at Greenwich Observatory on 199 days during 1886, while photographs from India filled in the gaps for 164 days; so that the record of observations is complete for all but two days. The area of sun-spots and faculæ has continued to decline during 1886 and 1887. There were 61 days in 1886, and from October to April 17th last, 73 days on which no spots appeared.

OBITUARY NOTES.

Charles Rau, one of the curators of the Smithsonian Institution, died in Washington, July 28th, at about seventy years of age. He was invited by Professor Henry about forty years ago to come to the United States and take a position in the Smithsonian Institution. He was the author of archæological books, and of numerous special articles in his chosen study.

Dr. Moritz Wagner, professor in the University of Munich, a distinguished traveler and scientific writer, died May 31st.

The death of M. Issartier, a French senator and mayor, formerly an eminent medical man, is reported. M. Issartier had long given up the practice of medicine, and had devoted himself to horticulture and scientific agriculture. He published a treatise on the cultivation of fruit-trees, and a course in agriculture.

Ivan Polyakoff, who died recently at St. Petersburg, at about forty years of age, was regarded as one of the most promising Russian men of science. His particular field was in botany and zoölogy. His earlier papers were published in the "Irkutsk Gazette." He was engaged upon expeditions from the Lena gold-washings to Transbaikalia, in the Olonetz region, the middle Volga, the lower Obi region and Saghalien, and the Pacific littoral. He was attacked with his final illness on his return from the last journey. He was the author of the accepted description of Prjevalsky's horse, "Equus Prjevalski."

CARL WILHELM SCHEELE.